Signal Theory and
Communications Department

MASTER THESIS

TELECOMMUNICATION SERVICE DEPLOYMENT:

PROJECT MANAGEMENT OPTIMIZATION BY USING DIFFERENT METHODOLOGIES

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Título: Telecommunication service deployment: Project Management optimization by using different methodologies.

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Realizado el acto de defensa y lectura del Proyecto Fin de Carrera el día 22 de Junio de 2015 en Leganés, en la Escuela Politécnica Superior de la Universidad Carlos III de Madrid, acuerda otorgarle la CALIFICACIÓN de :

VOCAL

SECRETARIO PRESIDENTE

The management of a project is like a sirtaki: it is worth to take your time to prepare it slow to be able to execute it fast and clean.

Muy especialmente a mi madre,
cuyo apoyo y colaboración han sido imprescindibles.
A mi padre, a mis abuelos,
a mi hermana,
a Luiscar y a Sofía,
a mis primas Flora y Angelita,
y a mi tutora de proyecto.

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Resumen

En las últimas décadas la Gestión de Proyectos se ha convertido en una disciplina omnipresente y en un factor estratégico clave para las grandes multinacionales.

Existe una demanda creciente de profesionales capaces de gestionar proyectos adecuadamente así como un gran número de metodologías de Gestión de Proyectos luchando por ganarse la distinción de "Metodología de referencia".

Tradicionalmente los proyectos de despliegue de servicios de telecomunicaciones se han gestionado aplicando una única metodología. A pesar de esto, en este proyecto fin de carrera se aplica un enfoque completamente distinto. Este enfoque consiste en aprovechar la combinación de distintas metodologías, considerándolas complementarias en lugar de excluyentes, para optimizar la gestión de los proyectos. Para que el lector pueda tener una visión lo más cercana a la realidad posible se ha desarrollado un caso de estudio basado en casos reales de la propia experiencia laboral de la autora.

Al mismo tiempo se pretende, por un lado, dotar al lector de los conceptos y herramientas necesarias para afrontar la elección de una (o varias) metodologías de gestión y, por otro, minimizar la confusión existente entre cuerpos de conocimiento, metodologías, instituciones y asociaciones.

Palabras clave:
Proyecto, gestión, gestor de proyectos, metodología, cuerpo de conocimiento, selección, elección, plantilla, optimización, predictivo, ágil, adaptativo, metodología lean, despliegue, estimación.

Abstract

In the last decades Project Management has become an omnipresent discipline and a key strategic factor of success in big international companies.

There is an increasing demand for professionals who are able to conveniently manage projects and a big number of Project Management methodologies fighting to gain the distinction of the "Reference methodology".

Telecommunication service deployment projects have been traditionally managed using a unique methodology. Despite of this, in this master thesis a completely different approach will be applied. This approach consists of profiting of the combination of different methodologies, considering them non-exclusive but complimentary, in order to optimize the management of projects. A case study based on the professional experience of the author has been developed so that the reader can get a vision as close to the reality as possible.

At the same time this master thesis tries to provide the reader with the concepts and tools needed to successfully face the selection of one (or several) management methodologies and also minimize the existing confusion in the field related to bodies of knowledge, methodologies, institutions and associations.

Key words:
Project management, project manager, methodology, body of knowledge, selection, choice, template, project, optimization, predictive, agile, adaptive, lean methodology, deployment, estimate.

Chapter I: Motivation

1.1. Personal motivation

When I decided to write my final project on the issue Project Management my first aim was to study the different project management methodologies or standards most widely used. The idea was to compare them and get to know which of them was the most suitable for the projects I have to deal with in my daily life as well as describe the accomplishment of a project using it so that the obtained result could guide engineers with no experience in project management to face their first projects.

When reading books or attending courses and seminars on Project Management I have always missed some real life examples that could guide and inspire me in the hard task of resolving the practical issues I was facing in real life. Usually the "teaching-like" projects showed did not address the real scope of the worries that a Project Manager has to deal with. I write this master thesis with the hope of giving the added value of the practical real-life case focus.

In my search of information I have read a lot about the different approaches on project management getting to the conclusion that a good way to face a project is firstly to identify the type of project we are dealing with and secondly use a combination of the methodologies or standards of that category because they are actually not different choices but complementary approaches and even some ideas of the category we have discarded in the first step might be applied to our project.

There are many approaches to manage a project but most of them are the result of the tuning of the most known to the specific needs of the organizations that define them.

About me:

Working as a Project Manager since 2009, I have collected international experience in Germany and France thus getting to know the way they work and attending some seminars in Project Management in those countries as well.

I am also interested in Service Management, certified in ITIL Foundations v3.0 in 2012, Process Management, Human Resource Management in international environments, and in general in everything around the management of technological projects.

1.2. Why apply Project Management?

Previously to considering the reasons why we should apply (or not) Project Management, let's quickly review what it is:

In general Project Management is the discipline of planning, organizing, motivating, and controlling resources to achieve specific goals, as we can find out if we look it up in a free generalist source like Wikipedia.

And more specifically, according to the Project Management Institute, (PMI) Project Management is the application of knowledge, skills and techniques to execute projects effectively and efficiently. It is a strategic competency for organizations, enabling them to tie project results to business goals — and thus, better compete in their markets. [1]

In the previous definition we have talked about **projects** which can be defined as a temporary group of activities designed to produce a unique product, service or result [1].

So the definition of Project Management according to the PMI gives us already a good reason for applying this discipline, given that it estates that it is a competitive advantage for organizations.

PMI showed in its 2014 annual global survey of Project Management practitioners, whose title was "The high cost of low performance" [2] that high-performing organizations successfully complete 89 percent of their projects, while low performers complete only 36 percent successfully. This difference in success results in high-performing organizations wasting nearly 12 times less than low performers.

But, what is a high-performing organization?

Based on the comparison of an extensive selection of scientific and non-scientific management literature, PhD. André A. de Waal, professor and researcher at the Maastricht School of Management in the Netherlands and director of the Center for Organizational Performance, an organization which conducts research into high performance organizations, has defined a high performing organization as follows:

A **high performing organization** is an organization that achieves financial results and non-financial results that are better than those of its peer group over a period of time of at least five to ten years. [3]

And these organizations will achieve these outstanding results, according to the research, by being able to adapt well to changes and react to these quickly, by managing for the long term, by setting up an integrated and aligned management structure, by continuously improving its core capabilities, and by truly treating its employees as its main assets.

Project Management is not explicitly mentioned but it is a key factor to perform all the activities that transform an organization into a high performing organization, and so it has been showed by the results obtained by the PMI in its 2014 global annual survey:

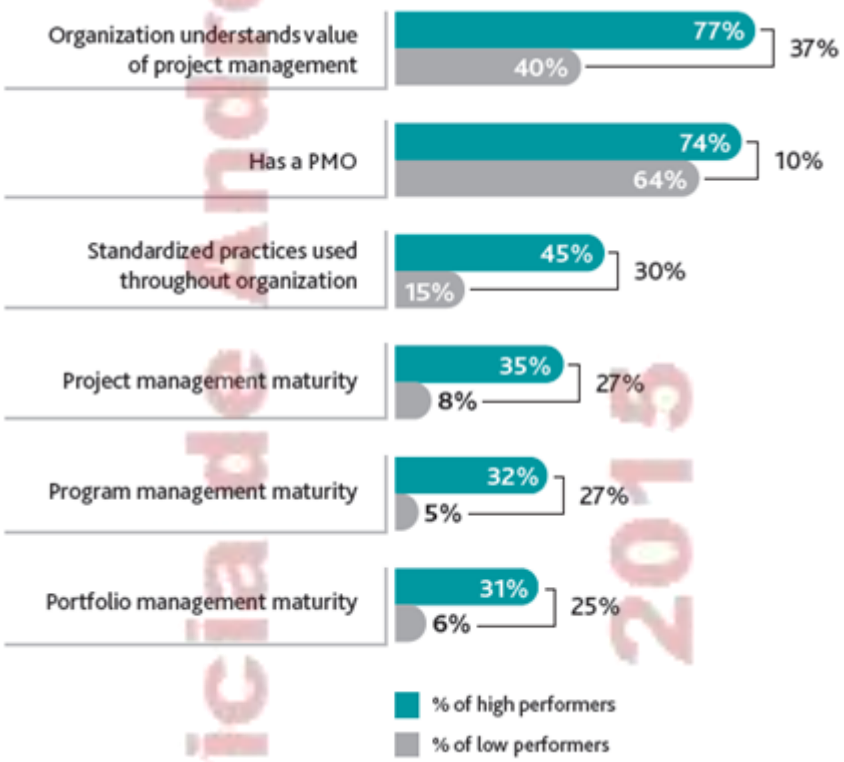


Figure 1 Characteristics of high performers vs low performers [2]

As we see Project Management seems to be a big competitive advantage worth having in a world becoming more competitive every day.

There is nevertheless a vast field of study concerning high-performing organizations given that according to the results of the survey there are 27% of high performing organizations not understanding the value of project management who nevertheless are doing well at achieving good results over time.

How get these organizations to manage the clue aspects of high performing organizations without having some guidance? It would be a revealing piece of information to know if their employees do understand the value of Project Management and if they have received any training in the area.

With this idea in mind a study on this issue has been performed within the framework of this master thesis with the premises and results that will be shown next.

The survey was prepared on the basis of these questions:

How will be the data collected? Through an online survey.

Who will be the target participants? Fifty people, working in projects (desired but not necessarily project managers)

Which will be the language used? As the survey will be sent to Spanish people it will be done in Spanish to increase the probability of getting answers.

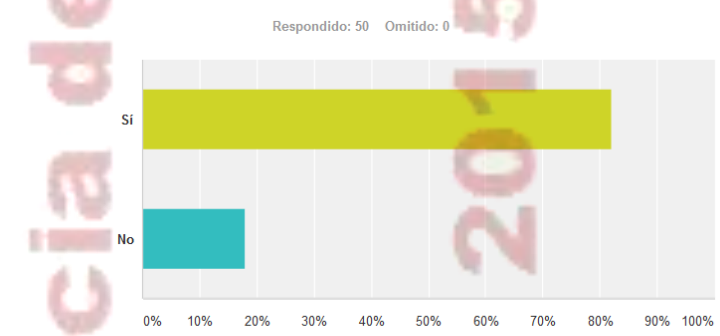
Which is the target sector? Different sectors as long as the work is organized in projects.

What will be the questions about? There will be specific questions concerning different Project Management methodologies and general questions, to get information about the perception of Project Management by the participants.

A trap question will be added, just a little evil intention to see what happens!

And here are the results (obtained through the free online survey system SurveyMonkey [4]):

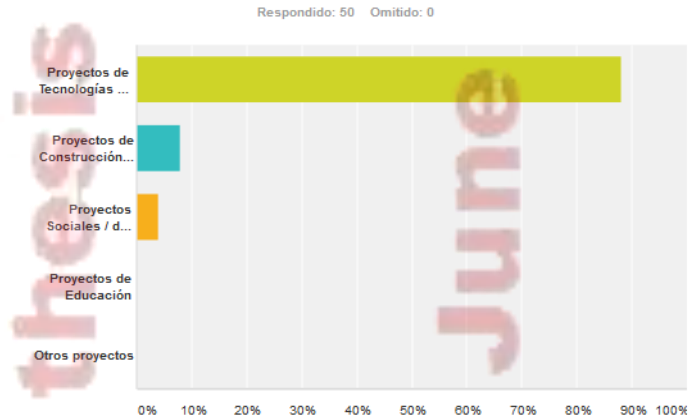
1. Do you work as a Project Manager?



Opciones de respuesta	Respuestas	
Sí	82,00%	41
No	18,00%	9
Total		50

Figure 2 Survey results - question 1

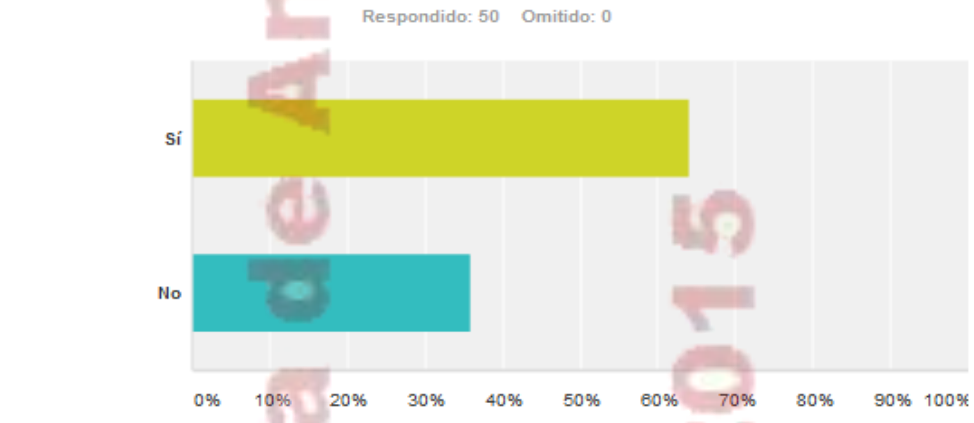
2. In which kind of projects do you work?



Opciones de respuesta	Respuestas	
Proyectos de Tecnologías de la Información y Comunicaciones	88,00%	44
Proyectos de Construcción / Ingeniería	8,00%	4
Proyectos Sociales / de Cooperación	4,00%	2
Proyectos de Educación	0,00%	0
Otros proyectos	0,00%	0
Total		50

Figure 3 Survey results - question 2

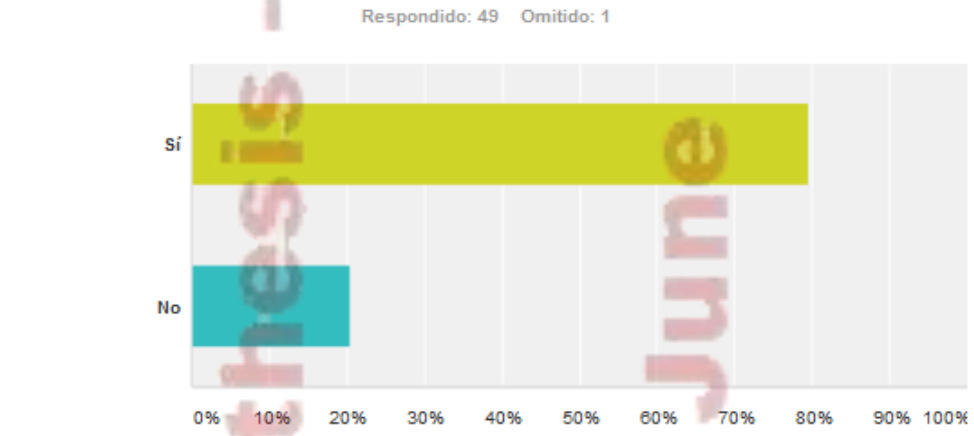
3. Did you receive training in Project Management methodologies or techniques?



Opciones de respuesta	Respuestas	
Sí	64,00%	32
No	36,00%	18
Total		50

Figure 4 - Survey results - question 3

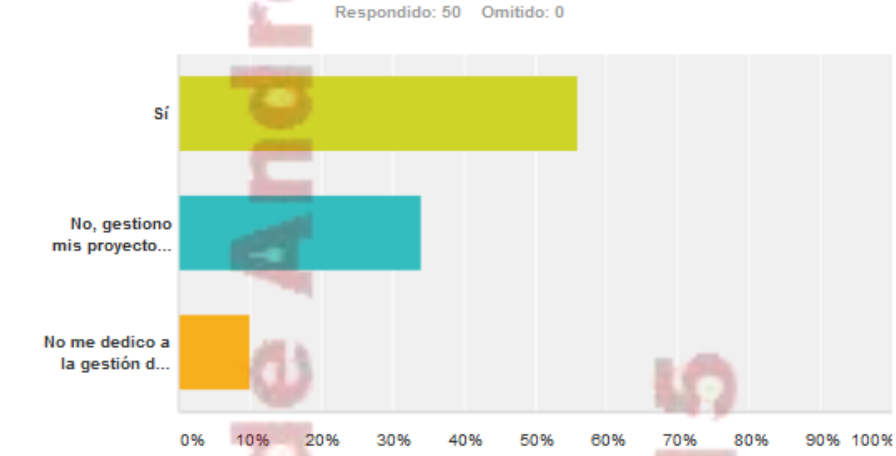
4. Does your organization use or recommend any Project Management methodology?



Opciones de respuesta	Respuestas	
Sí	79,59%	39
No	20,41%	10
Total		49

Figure 5 Survey results - question 4

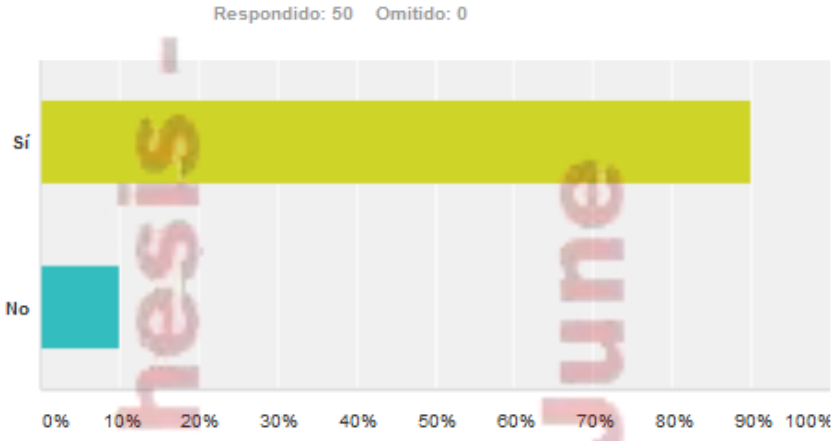
5. Do you use any Project Management methodology?



Opciones de respuesta	Respuestas	
Sí	56,00%	28
No, gestiono mis proyectos sin aplicar una metodología concreta	34,00%	17
No me dedico a la gestión de proyectos	10,00%	5
Total		50

Figure 6 Survey results - question 5

6. Do you consider that using a Project Management methodology improves the results obtained by projects?



Opciones de respuesta	Respuestas	
Sí	90,00%	45
No	10,00%	5
Total		50

Figure 7 Survey results - question 6

7. Which from these Project Management methodologies do you know?

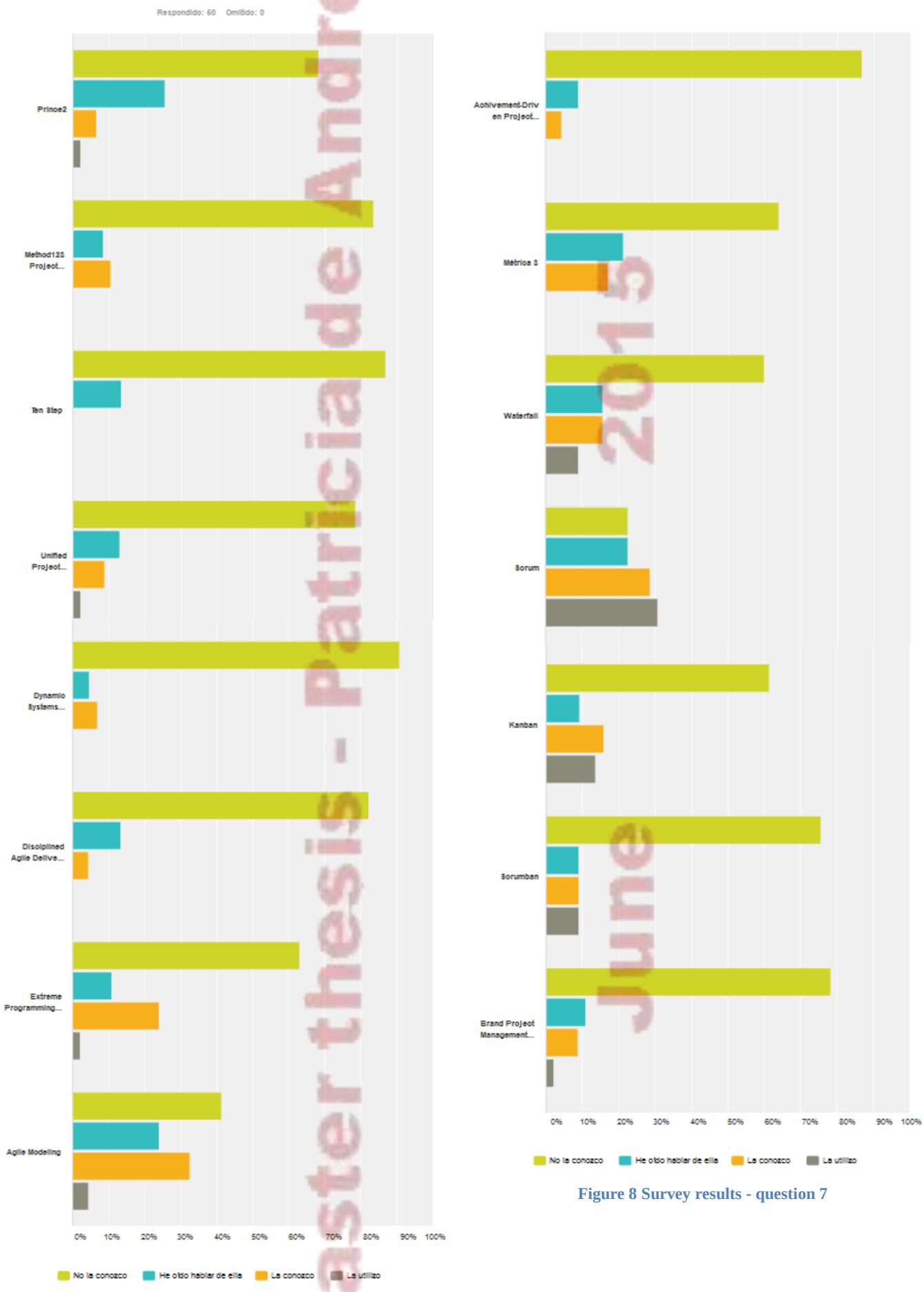


Figure 8 Survey results - question 7

	I do not know it	I have heard about it	I know it	I use it	Total
Prince2	68,09% 32	25,53% 12	6,38% 3	2,13% 1	47
Method123 Project Management Methodology (MPMM)	83,33% 40	8,33% 4	10,42% 5	0,00% 0	48
Ten Step	86,67% 39	13,33% 6	0,00% 0	0,00% 0	45
Unified Project Management Methodology (UPMM)	78,26% 36	13,04% 6	8,70% 4	2,17% 1	46
Achivement-Driven Project Management Methodology (ADPM)	86,67% 39	8,89% 4	4,44% 2	0,00% 0	45
Métrica 3	63,83% 30	21,28% 10	17,02% 8	0,00% 0	47
Waterfall	60,00% 27	15,56% 7	15,56% 7	8,89% 4	45
Scrum	22,45% 11	22,45% 11	28,57% 14	30,61% 15	49
Dynamic Systems Development Method (DSDM)	90,91% 40	4,55% 2	6,82% 3	0,00% 0	44
Disciplined Agile Delivery Framework Process (DAD)	82,22% 37	13,33% 6	4,44% 2	0,00% 0	45
Extreme Programming (XP)	63,04% 29	10,87% 5	23,91% 11	2,17% 1	46
Agile Modeling	41,30% 19	23,91% 11	32,61% 15	4,35% 2	46
Kanban	61,36% 27	9,09% 4	15,91% 7	13,64% 6	44
Scrumban	75,56% 34	8,89% 4	8,89% 4	8,89% 4	45
Brand Project Management Process (BPMP)	78,26% 36	**10,87%** 5	**8,70%** 4	**2,17%** 1	46

Figure 9 Survey results - question 7 in figures

Our trap question is part of question 6. In effect, Brand Project Management Process is the intruder methodology that was invented ad hoc and hidden among the others (it has just been placed in the last place to show the results and make the reader aware of it).

Surprisingly 10 participants, that is one out of five affirms to know or having heard about this methodology and even one of the participants says he/she uses it.

I guess the participants have taken the acronym “BPMP” for the acronym “PMP” which usually stands for “Project Management Professional” and it is not a methodology itself but the name of the credential granted by the PMI (Project Management Institute) to the people that have successfully passed an exam to evaluate the knowledge of Project Management, taking the PMBOK (Project Management Body of Knowledge, that we will present later in this master thesis) as the basis.

This question shows to which extent the abuse of acronyms can lead to misunderstandings in the field of Project Management.

There is still another issue: the fact that even professionals in Project Management do not have a clear vision of what is a methodology, a body of knowledge, a credential, etc. In the next chapter we will show how all these concepts are organized.

There was still an eighth open question where we find further evidence of this:" Do you use another methodology not listed before? Which one?" Ten participants answered the question. Most of them talked about PMI (which is an association), and others about PMBOK (which is a body of knowledge) and PMP (which is a credential).

Apart from the little tricky question, **what we learn from the answers is that in general the use of a methodology is seen as a very positive and desirable thing to do given that although only 58% of the participants use a methodology to manage their projects, 90% have the perception that the use of a methodology improves the results obtained.**

Chapter II: Project Management approaches and methodologies

2.1. Some concepts about Project Management

There are so many Project Management approaches as project managers. The trick is to know so many as you can to have a wider choice of techniques to apply when managing your projects.

At first, being a non-experienced project manager it is useful to choose only one, usually the one used in your organization (if there is one methodology officially used) to which you will have to adapt concerning the documents you have to produce during the life of the project. It will serve you as a guide so that you will not feel so lost facing your first project. Consider asking for advice to other colleagues more experienced. After some time you will find your place, preferred techniques and also you will feel more comfortable in your position and with your estimations.

“Estimation” is a key word in Project Management. Estimate according to the Oxford dictionary means “roughly calculate or judge the value, number, quantity, or extent of something”. Project Management is about estimating. Estimating time to complete tasks, costs, risks...

Let’s review some other concepts we will hear of a lot when dealing with Project Management.

Methodology: The term has its origin in the greek words “metà” (further) and “odòs” (way). In effect connecting these words we obtain the definition of “method” that is a way to go further, the things that need to be done to achieve some objectives. If we consider the third word of the compound “logos”, commonly translated as “word” or “knowledge”, we realize that it refers to a way to do something based in knowledge, science or investigation.

The previous one is a very general definition, but if we think of the IT projects environment the following definition is more accurate:

“Methodology is a set of guidelines or principles that can be tailored and applied to a specific situation. In a project environment, these guidelines might be a list of things to do. A methodology could also be a specific approach, templates, forms, and even checklists used over the project life cycle” [5]

Framework: In software development it is a working environment, usually referring to a group of cohesive applications (a suite) and tools to make it easier to achieve an objective. It can also be a group of best practices, rules and methods to achieve an objective.

Standard: A model, reference pattern, criteria or rules that a product has to meet to assure a certain quality or the compliance to a certain qualification.

Body of knowledge: It is basically a compilation of the knowledge on a topic or industry. According to the Wikipedia it is a complete set of concepts, terms and activities that make up a professional domain, as defined by the relevant learned society or professional association. A body of knowledge is the accepted ontology for a specific domain. It is more than simply a collection of terms; a professional reading list; a library; a website or a collection of websites; a description of professional functions; or even a collection of information.

The bodies of knowledge do not give a specific implementation; they give response to the question “What should I know to manage projects?” or actually “What do we know about Project Management?” They are not “how to” guides, but a description of what your implementation should do, to improve effectiveness and performance.

2.2. Project Management approaches

We can distinguish three basic approaches to Project Management:

Predictive

The Project Manager predicts or anticipates what is going to happen all along the life of the project, telling who, how and, most important, when every task necessary for the project must be performed.

It is process-oriented. Planning is the core of the approach and changes are to avoid as much as possible. It requires a stable environment and a fixed scope of the project. There is no functional result until the end.

Agile

The final requirements are unknown or not completely defined at the beginning of the project. The final value of the project is very important or the project has been created to innovate in some industry.

Changes are taken as a natural part of the process and they are considered a source of added value for the final result. It is also called adaptive.

The work is organized in short periods of time called sprints or iterations that last typically from 1 to 4 weeks, having each of these iterations some fixed phases to complete. These fixed phases act as a kind of mini-cycles or waterfalls understood in the predictive manner.

A functional prototype that the client can test is obtained after each iteration, so that misunderstandings or risks can be identified at an early time. It focuses on the people and their interaction.

Strong interaction with the client is needed and indeed the client is considered as a part of the team.

Lean

This approach consists in minimizing the amount of management in projects with a philosophy “less is more” like.

Its origins have a long history but it is considered an evolution of the Agile approach, consisting in adopting concepts of Lean Manufacturing and integrating them with the agile way of managing projects in an effort to simplify it as much as possible.

Lean manufacturing which was originally used in Japan is about minimizing waste products such as over-production, waiting time, human capacity underused, transportation... etc., to reduce costs and time to market, at the same time quality is improved.

This type of manufacturing presumes a continued measuring and analysis of the process to promote a continuous improvement. The continuous improvement is usually referred with the Japanese term “kaizen”. The final objective is to achieve a one-shot way of producing i.e. getting the product ready with the quality required at the first attempt.

2.3. Project Management associations and Bodies of knowledge

In Spain only one Project Management association and only one body of knowledge has become popular, that is PMI and its PMBOK, nevertheless we can consider up to four associations to be the most influent in the topic around the world.

Each of these associations has developed its own body of knowledge. All of them have in common being non-profit associations and have the aim to promote and give content, structure and guidance for Project Management.

PMI & PMBOK

www.pmi.org/ [6] [1]

PMI stands for Project Management Institute. It is a worldwide non-profit organization founded in 1969 in Pennsylvania.

PMI standards are developed by volunteers in an open, consensus-based process including an exposure draft process that allows the public to view the standard draft and make change suggestions.

PMBOK, Project Management Body of Knowledge [1] is a guide released by PMI made out of good practices (set of "practices that are common to most projects, most of the time") of the industry, based on the experience of its contributors, and it is worldwide recognized as the reference for Project Management.

Historically PMBOK has had a predictive approach to Project Management, nevertheless in its last version (version 5) it also addresses the adaptive approach and several extensions have been published for specific industries. Among them, especially interesting for us is the Software Extension [7].

PMBOK focuses mostly on individual projects, knowledge and areas of Project Management but, as any body of knowledge, it does not specify the techniques or procedures to use and also it does not analyse external circumstances that might affect Project Management, such as the economic and social environment.

IPMA & ICB

http://ipma.ch/ [8]

IPMA is the acronym for International Project Management Association. This association founded in 1965 in Vienna is the oldest Project Management association in the world. It groups a set of more than 50 Project Management associations of national and international scope.

ICB (IPMA Competence Baseline) [9] is based on best practices and focused on providing a managerial model to evaluate Project Management competence; this objective is addressed by PMI in a separate document from its body of knowledge called PMCDF (Project Management Competence Development Framework) [10].

ICB also contains a basis of knowledge, experience and personal attitudes in Project Management aiming not only to enhance personal abilities and professional competence, but also enable collaboration within and across organizations.

In Spain a member of IPMA, AIEPRO (Asociación Española de Ingeniería de Proyectos) [11] has adopted ICB, adapted it to the particularities of the Spanish market and released it with the name NCB (National Compentence Baseline).

APM & APMBOK

www.apm.org.uk/ [12]

APM stands for Association of Project Management. This association, founded in 1972 and established in UK, is part of the IPMA.

Its body of knowledge's name is APMBOK (APM Body of Knowledge) [13] and was firstly released 20 years after the birth of the association, in 1992.

According to APM APMBOK defines the breath of the project, programme and portfolio management profession. Much like the PMBOK it is also collaborative and based on the experience of practitioners.

PMAJ & P2M

www.pmaj.or.jp/ENG/ [14]

PMAJ meaning Project Management Association of Japan was founded in 2002, and it is in charge of maintaining and promoting its body of knowledge, called P2M.

P2M [15] is not an acronym but a name and it is about value generation for organizations through enterprise innovation, "a guidebook for project and program management for enterprise innovation".

In the words of PMAJ P2M is "a tool which is usable by everyone to achieve the same purpose of cooperation between different cultures and foreigners".

It has been created as an answer to the new challenges that overcome the discipline: increasing number and type of stakeholders in a global world where dealing with things from a holistic viewpoint transcending specialized fields has become a must.

2.4. Comparison of the Bodies of Knowledge presented

The comparison of these bodies of knowledge is complex and deserves a deep study itself; nevertheless some general conclusions can be obtained as a result of a preliminary study. [16]

All of them consider a project lifecycle, the same basic concepts and hierarchical relations between project, program and portfolio, and the classical Project Management variables: time, cost, and scope.

But, in general, they have different points of interest:

- PMBOK: Individual projects, processes
- ICB & APMBOK: Personal skills
- P2M: Value generation

Thus for ICB and APMBOK the success of a project is highly dependent on the personal skills of the project manager, while for PMBOK the key of success is the right execution of processes.

PMBOK does not consider environmental social and economic circumstances while the others bodies of knowledge do and adapt.

Also the level of detail for each topic differs among the standards considered.

There are so many strategic goals as organizations and the standard to follow should be chosen considering the particularities of each case, and in some cases more than one, if all the issues are not considered by just one.

2.5. Project Management methodologies

In this section we will consider the term “Methodology” as a specific and practical implementation of a standard or a part of a standard. It typically provides project managers with processes ready to follow with small or no need for adaptation as well as templates and other tools and techniques. It also integrates a common terminology that all stakeholders must know and use to communicate with each other and release the documents related to the project.

When applying a methodology it is important to always keep in mind that the managerial effort done should be worth compared to the benefits that will be obtained from applying it.

Once a methodology is chosen, with the agreement of the organization and of all the stakeholders involved in the project (which is sometimes not easy to achieve, moreover if there is no previous experience in using Project Management methodologies, or the existent is different from the most suitable for the actual project, or even there is no Project Management culture at all in the organization) there is still a non-negligible effort to do to adapt the methodology so that it fits perfectly the needs of the project.

There is no single methodology that can fit every and all project needs in the world, this is precisely the “raison d’être” of this final project and also showing in a easy to read fashion for future or junior project managers how we can benefit from knowing and applying different methodologies.

2.5.1. PREDICTIVE METHODOLOGIES

2.5.1.1. Prince2

www.prince2.com [17]

PRINCE2, [18] [19] “Projects in controlled environments version 2”, is used extensively in United Kingdom as the de facto project management standard for public projects management, control and organisation.

It is a generic methodology, which means that it is aimed for every kind of project, independently of the industry of the organization, and for any size from, for example, building a spacecraft to organizing a birthday party.

On the other hand it is specific. This might look much like a contradiction but it is specific in the sense that, being a methodology (review the definition given in section 1) it provides specific ways to do most (if not all) of the managerial work due to achieve the objectives of the project.

PRINCE2 is based on the principles of the PMBOK.

PRINCE2 consists of four parts (or elements in PRINCE2 terminology) which are:

- Principles (or best practices)

- Themes (which are recurrent to every project, such as Business Case, Organization, Quality, Plans, Risk, Change, and Progress)
- Processes
- And Tailoring (or how to adapt PRINCE2 to a real case)

The core of PRINCE2 is its Process Model [20], which is a graphical representation of the seven processes that have to be executed in the life of a project. These seven processes, that might be executed one or more times depending on the process, are:

- Starting up a Project (SU)
- Initiating a Project (IP)
- Directing a Project (DP)
- Controlling a Stage (CS)
- Managing a Stage Boundary (SB)
- Managing Product Delivery (MP)
- Closing a Project (CP)

A simplified representation of the Process Model extracted from http://www.prince2.com/prince2-processes is shown below:

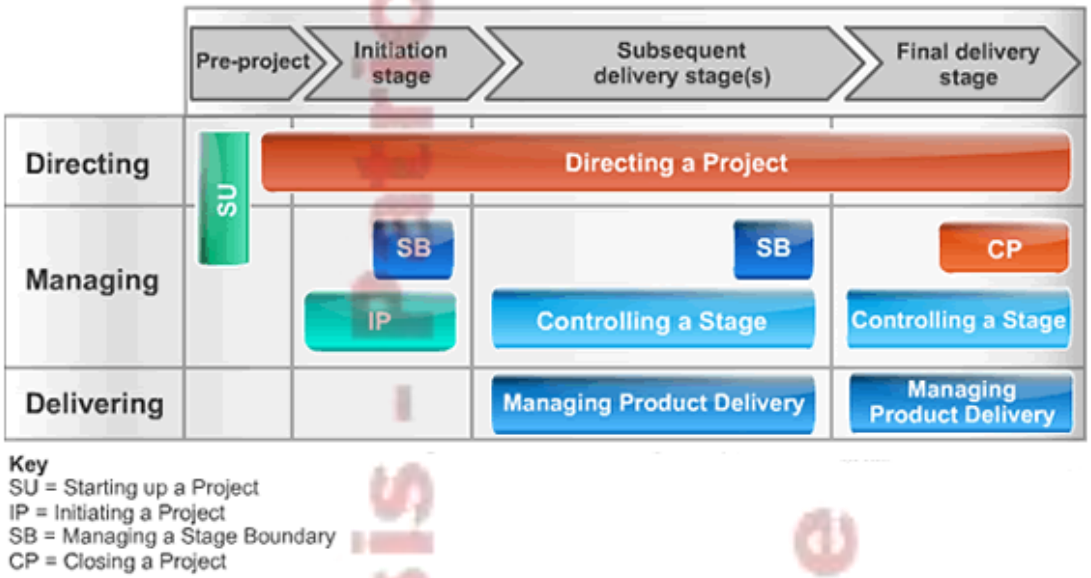


Figure 10 PRINCE2 Process Model [17]

In the representation we can see the different processes and how they relate to the different phases of the lifecycle of a project as well as to the different levels of management of the project (on the left side).

2.5.1.2. Method123 Project Management methodology (MPMM)

www.mpmm.com [21]

Based on PMBOK, it claims to be suitable for all types of projects regardless of the size or industry. It provides project managers with tasks, charts, tables, examples, (templates, forms, checklists) and Project Management processes to guide and support project managers in the way they control a wide variety of aspects of a project such as time, quality or communications management among others.

It can be considered another implementation of PMBOK inspired on PRINCE2.

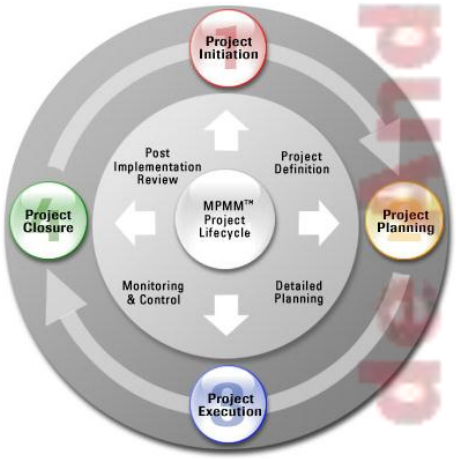


Figure 11 MPMM Lifecycle [21]

From the point of view of MPMM the project lifecycle has 4 phases:

- Initiation
- Planning
- Execution
- Closure

It is available in three versions, professional, standard, and educational, where the major differences are the public to whom the versions are intended and the customization feature of the professional edition that allows the project manager to adapt the methodology to the particularities of the project he/she is working on.

2.5.1.3. Critical Chain Project Management

CCPM or Critical Chain Project Management is a methodology, developed by Eliyahu M. Goldratt in 1997, especially suited for organizations where the management of resources plays a key role. [22]

It is a very analytic methodology. The idea is to identify the longest path in the chain of activities that have to be undertaken in a project and make sure that the resources needed to accomplish them are available. The activities must be reordered with this criterion in mind.

For identifying the longest path, i.e. the longest chain of activities which is called “the critical chain” from where the methodology takes its name, it is necessary to make a very strict plan eliminating the buffers for activities that are traditionally added.

Instead of planning including buffers for activities (or extra time to make sure that the deadlines are met), the Critical Chain method proposes to manage uncertainties, that is unexpected circumstances that might arise during the project, by including a unique buffer at the end.

2.5.1.4. TenStep Project Management Process

www.tensteppm.com [23]

It is a methodology for managing work as a project based on the PMBOK and ISO 21500 (ISO 21500 is the standard or body of knowledge for Project Management published by ISO in 2012 and it is so strongly based on PMBOK that we will not further consider it in a separate section).

TenStep is a step by step approach suitable for projects of all sizes. The basic philosophy is “large methodology for large projects, small methodology for small projects”, this means “to

apply a sufficient level of project management". The processes are defined and the tools are implemented with this principle in mind.

The methodology is structured in two views. The first view contains the ten most important processes of Project Management according to this methodology. The other view contains the groups of processes in a similar manner as described by the PMBOK.
The two views are represented as follows:

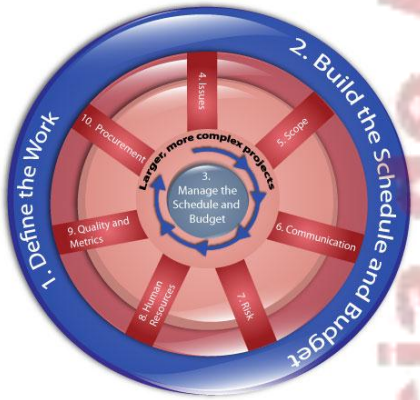


Figure 13 TenStep Process View [23]

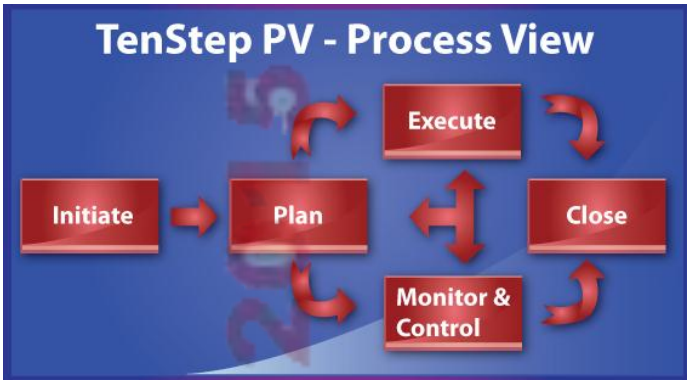


Figure 12 TenStep Group of Process View [23]

It is very important to keep in mind that TenStep is about managing all the work that has to be done around the project so that the project is successful but it does not define how to manage the work of the project itself which is referred as " the project life cycle" so an additional methodology should be considered.

It provides a wide variety of templates that you can get by buying them at the web page.

2.5.1.5. Unified Project Management Methodology (UPMM)

www.iil.com/pm/upmm/ [24]

Also based on PMBOK, promises its practitioners that they will be able to follow the standard with minimal effort.

It is actually a suite of process-based software tools, interactive roadmaps and a set of templates, examples, guidelines, procedures, policies, best practices and a large online knowledge base.

It is strongly oriented to communication and collaboration which makes it a good choice when the members of the team are far and dispersed but nevertheless a high level of real-time communication is needed.

It is available in three different versions:

- UPMM Software Suite (the standard set of tools).
- UPMM Powered by PIEmatrix (integrated with PIEmatrix, a cloud-based platform used to share all the information managed in UPMM).

- UPMM in SharePoint 2010 (integrated with Sharepoint to make easier the management of knowledge and facilitate collaboration and communication among the organization).

2.5.1.6. Achivement-driven Project Methodology (AdPM)

http://4pm.com/about-4pm-com/project-methodology/ [25] [26]

This methodology was designed for cross-functional corporate projects and its philosophy can be expressed as “Just the right techniques for each project”

The creators of this methodology consider that the basics of the Methodology is well suited for at least 80% of the projects done in most organizations while the other 20% must be managed using the advanced techniques also provided.

It is based on a process consisting of 5 steps:

1-Plan the project with top-down techniques
2-Decompose project goal into a deliverable network
3-Create one-page broad-brush plan for executive review
4-Optimize the schedule with accurate estimates; 10 min/week to update
5-Spot & report problems early

2.5.1.7. Other methodologies related

The methodologies we will consider in this section are not purely Project Management methodologies but they are included for the reasons that will be explained later for each of them.

Métrica v.3

http://administracionelectronica.gob.es/pae_Home/pae_Documentacion/pae_Metodolog/pae_Metrica_v3.html [27]

We talk about Métrica v.3 because it has been developed by the Spanish Ministerio de Hacienda y Administraciones Públicas and it is widely used (and required) in the public sector.

It is near but it is not a Project Management methodology but an Information Systems Development Methodology in which one of its parts gives guideline to the way for the planning, monitoring and controlling of tasks, human resources and components used to build an Information System (which are typical activities considered in Project Management).

Being focused on the information system it considers not only the development of the information system but also the maintenance. On the other side, not being a pure Project Management methodology it doesn’t address some issues that every Project Management Methodology should address such as, to mention one example, risk management.

Its Project Management part considers three big types of activities: Initializing, monitoring and control, and finalization.

Waterfall

Waterfall is actually a step by step software development methodology and it is mentioned here for historical reasons, given that it is considered the ancestor of nowadays predictive methodologies. The term “Waterfall” is usually used as a synonym for “predictive”.

According to this model projects are deployed as a sequential design process whose phases are Requirements/analysis, Design, Coding, Testing, Maintenance.

It is important to outline that it also considers the maintenance of the software which, according to the definition of project that we have given in 2.1 is not part of the project (which has a fixed duration in time).

The model describes deliverables and a review process for each phase with no aliasing between phases; therefore it is simple to use it whereas in most real cases this is not the situation.

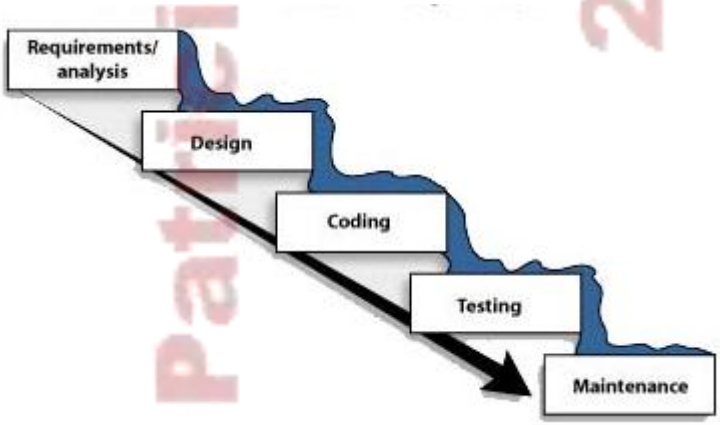


Figure 14 Waterfall lifcycle [28]

2.5.2. AGILE METHODOLOGIES

In this section we will study some agile, also called adaptive methodologies, for Project Management according to the definition given in 2.2.

The methodologies that we will review in this section, as well as adaptive methodologies in general are aimed to manage IT projects and more specifically Software Development projects.

This group of methodologies share some common characteristics or principles that where firstly formally written in 2001, when the Agile Manifesto [29] was published.

A totally different way of performing Project Management was proposed, where the elements valued the most changed dramatically in comparison with traditional Project Management approaches (predictive). [30]

In that sense Agile values:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

It is highly collaborative, not only inside the development team but also with other stakeholders like for example the client who becomes another team member. It is based on the following 12 principles:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.

2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.

3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale

4. Business people and developers must work together daily throughout the project.

5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.

6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.

7. Working software is the primary measure of progress.

8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

9. Continuous attention to technical excellence and good design enhances agility.
.
10. Simplicity--the art of maximizing the amount of work not done--is essential.

11. The best architectures, requirements, and designs emerge from self-organizing teams.

12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

2.5.2.1. Scrum

www.scrum.org [31] [32] [33]

This is not an acronym but a reference to rugby (the manner of restarting the game after a minor infraction).

Scrum is a simple framework for effective team collaboration in complex projects. The point of Scrum is telling how teams can be organized to produce software in a changing environment. It tries to provide the essential structure that teams need to organize themselves and be able to focus on innovation and problem solving.

Scrum creators have a very nice way to state the philosophy of Scrum saying that “It supports our need to be human at work: to belong, to learn, to do, to create and be creative, to grow, to improve, and to interact with other people, that is it leverages the innate traits and characteristics in people to allow them to do great things together”.

In this method daily quick meetings (15 minutes typically) are done with the team to review the evolution of the project the day before and plan the activity for the day. It is also used to check if something is blocking the activity.

Three roles are defined (product owner, development team, scrum master). The product owner would be the client, the person or company or society that has a need the team is in charge of fulfill and the scrum master is similar to the project manager but in fact there is no project manager at all in this approach, being the functions of the project manager split in the people playing the three roles mentioned. In the phase of development (we will talk about the phases next) periods of work called sprints or iterations are defined, that repeat once and again gaining more detail at each iteration. Also as a legacy of the rugby terminology the life cycle of a project consists of three phases:

Pre-game: (with the sub-phases “Planning architecture” and “High level design”) In this phase a Product Backlog is defined, that is a list of the tasks in order of priority that must be completed to get the product done. It is not a static document but a document which is alive and adapts to consider the changes that arise. The high level design created in this phase will be refined in the next phase.

Development: A series of iterations also called “sprints” each of them including five sub-phases (requirements, analysis, design, evolution and delivery). It is usual to perform from three to eight iterations.

Post-game: Final refining and delivery of the product. No changes are allowed in this closing phase.

2.5.2.2. Dynamic Systems Development Method (DSDM)

www.dsdm.org [34]

According to their creators this methodology is suitable for any size of project and industry, that is, not only software development.

The philosophy is that “any project must be aligned to clearly defined strategic goals and focus upon early delivery of real benefits to the business”.

This approach fixes time and resources and from that point it adjusts the amount of functionality that will be implemented.

It recommends the use of some well-known and proven techniques, such as:

- Facilitated workshops
- Modeling and iterative development
- MoSCoW prioritization
- Time boxing

It consists of five phases where the last three are iterative:

1. Feasibility study
2. Business study
3. Functional model iteration
4. Design and build iteration
5. Implementation

2.5.2.3. Disciplined Agile Delivery (DAD) Framework Process

http://disciplinedagiledelivery.com [35]

It is an extension of Scrum in an effort to give guidance for the aspects that Scrum ignores.

Disciplined Agile Delivery (DAD) process decision framework is a “people-first, learning-oriented hybrid agile approach to IT solution delivery. It has a risk-value delivery lifecycle, is goal-driven, is enterprise aware, and is scalable.”

It is called hybrid because it tries to integrate the best characteristics of a lot of other methodologies like, for example, Scrum, Extreme Programming, Kanban, Agile Modeling, Lean Software Development, and even Traditional Software Development, among others.

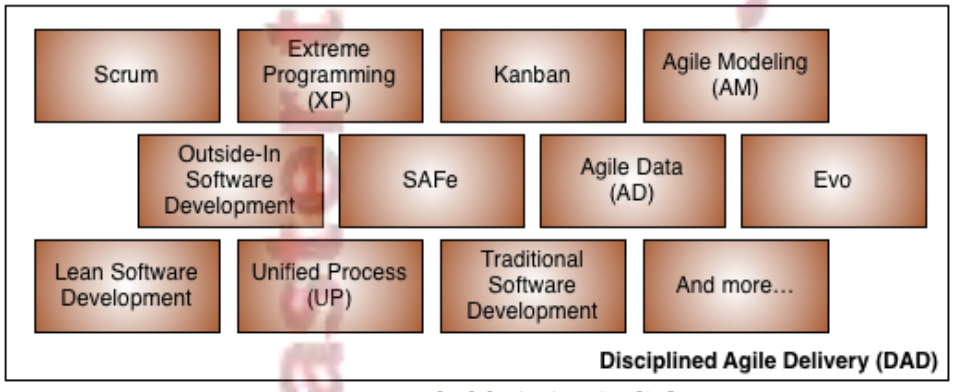


Figure 15 Methodologies in DAD [35]

2.5.2.4. Extreme Programming (XP)

www.extremeprogramming.org [36]

This is a software development methodology that stresses customer satisfaction, delivering the software you need as you need it. It is kept as simple as possible and its life cycle consists of five phases:

Exploration: collecting the requirements for the very first release while the team gets familiar with the technology involved and the tools it will use.

Planning: communicating with the customer to find out the features or functionalities that are more important from the customer point of view.

Iterations to Release: A set of incremental iterations working on the product are performed, After each of these iterations (typically one to four weeks) a pack of functional tests previously determined is executed.

Productionizing: The result of this phase is a finished release of the product. Still there can arise some changes here that will be implemented or let for a further release. Additional performance testing and checking is done so that the customer can be sure of receiving a product that meets his requirements.

Maintenance: Software is a living being so it is very likely to evolve. This evolution is considered during this phase and it can include corrections of bugs that had not been detected before, adaptations (usually a software is not alone in the world but integrated with several other pieces of software and therefore impacted by them), new functions or improvements (performance issues, etc.)

Death: This phase arrives when the customer is completely satisfied and therefore does not demand more changes. It is the time to complete the final documentation of the product. This is also the phase when the product becomes useless because the needs that it fulfilled no longer exist or it has become too expensive to adapt it to new challenges and it is obsolete.

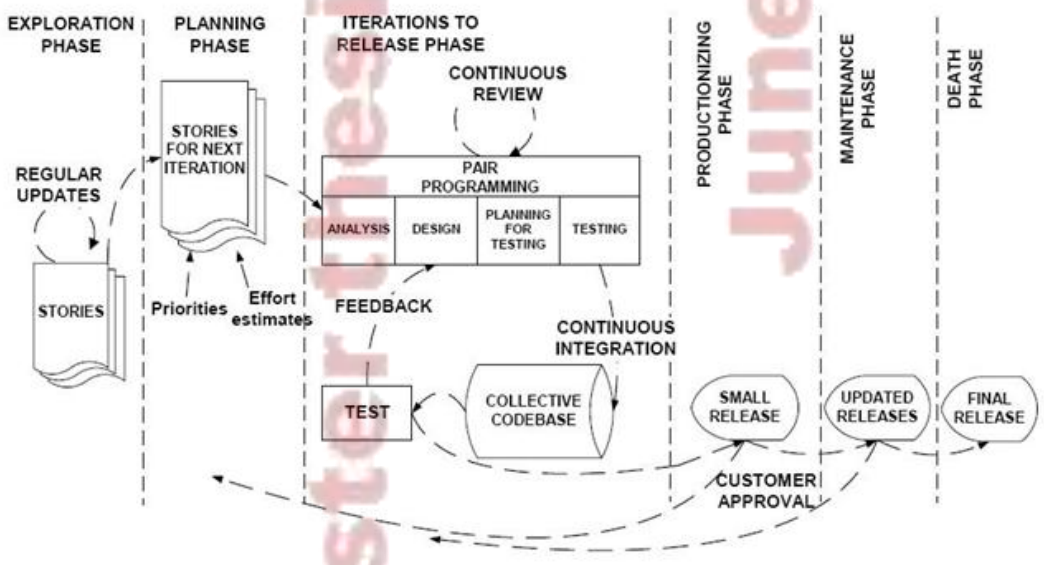


Figure 16 Phases of an iteration [36]

2.5.2.5. Other methodologies related

The methodologies that we will introduce in this section are often considered when talking about and comparing adaptive methodologies.

Test-driven development (TDD)

According to the Agile Alliance [37] "Test-driven development" refers to a style of programming in which three activities are tightly interwoven: coding, testing (in the form of writing unit tests) and design (in the form of refactoring).

Very basically explained in this style of programing the conception of the tests is done before the coding: once the tests are written the programmer codes the lines that are necessary to successfully pass the test.

Agile Modeling

www.agilemodeling.com [38]

Collection of best practices for modeling and documentation of software-based systems.

2.5.3. LEAN METHODOLOGIES

Lean methodologies are actually a subset of the Agile methodologies with the particularities discussed in 2.2.

2.5.3.1. Kanban

Inspired in Toyota's "just-in-time" (JIT) production system, its main feature is to reveal bottle necks dynamically.

To implement this methodology a board is used where all the tasks are stick. The name of the methodology has indeed literally almost that meaning; from the Japanese word “kan” whose meaning is “visual” and “ban” i.e. “card”. It is typical to see entire walls from development teams’ offices covered with colourful post-its, each of them representing a task.

The whole of the tasks is called the backlog (like in Scrum). Some of these tasks will be identified to be executed in the iteration. The tasks are ordered by priority in the board.

Kanban states four basic principles:

1. Start with what you do now.
2. Agree to pursue incremental, evolutionary change.

3. Respect the current process, roles, responsibilities and titles.
4. Leadership at all levels.

And has six core practices:

1. Visualize.
2. Limit work in progress.
3. Manage flow.
4. Make policies explicit.
5. Implement feedback loops.
6. Improve collaboratively, evolve experimentally (using models and the scientific method).

The Kanban method encourages small continuous, incremental and evolutionary changes and a shared common vision of theories about work, working processes and all the issues around Project Management, so that the team can discuss the better solution to the problems that it might face in a collaborative manner, sharing a common language.

2.5.3.2. Scrumban

A combination of Scrum and Kanban.

It is aimed at improving performance in teams that work in systems maintenance and, as a consequence it is not a truly Project Management methodology as the maintenance is not considered a project for being of an uncertain duration (typically long term).

In Scrum the focus is the change, or more specifically the capability of the team to adapt to it, whereas in Kanban the focus is set on limiting the work in progress at a time to keep high quality standards high and stress of the team low.

Scrumban tries to get the best of both worlds by adopting Scrum's daily meetings and practices, and limiting the work in progress at a moment in the same way as Kanban does. The sprints do not make sense in a maintenance service and therefore they do not exist in Scrumban.

2.6. Methodologies quick comparison

The following tables summarize at a glance the methodologies studied so far:

Predictive I :

PREDICTIVE	Based on	Year	Size of projects	More suitable for / Industry	Lifecycle	Other considerations
PRINCE2	PMBoK	1989	Any	Originally only for IT Version 2 suitable for any industry	Starting Initiating Directing Controlling Managing Stage Boundary Managing Product Delivery Closing	Widely used in the UK Standard in the public sector
MPMM	PMBoK PRINCE2	2006	Any	Any	Initiation Planning Execution Closure	Wrapped in project management software Provides templates
CCPM	Theory of constraints	1997	Any	Any	Planning Execution Monitoring	Manages limited resources and / or multitasking

PREDICTIVE	Based on	Year	Size of projects	More suitable for / Industry	Lifecycle	Other considerations
TenStep	PMBoK	2005	Any	Any	Initiate Plan Execute Monitor & control Close	Suited for internal projects with internal customers Does not include the project lifecycle Provides templates
UPMM	PMBoK	2001	Any	Any	Not known	Strong support for communication and collaboration Provides templates Wrapped in project management software
AdPM	PMBoK	Not known	Any	Any	Plan Decompose Plan for executive review Optimize the schedule Report	High scalability Provides templates

PREDICTIVE	Based on	Year	Size of projects	More suitable for / Industry	Lifecycle	Other considerations
METRICA3	ISO/IEC 12207 ISO/IEC 15504	1989		Information systems	Planning Development Maintenance	Spanish public sector
Waterfall		1970		Construction Adapted to software development	Requirements/Analysis Design Coding Testing Maintenance	Considers the maintenance

AGILE	Based on	Year	Size of projects	More suitable for / Industry	Lifecycle	Other considerations
Scrum	Agile Manifesto	1995	Small Techniques are offered to adapt it to bigger projects	SW development	Product backlog Sprint backlog Sprint Prototype	Does not cover the software development process
DSDM	Agile Manifesto	1995	Any	SW development	Preproject Feasibility Foundation Exploration Engineering Deployment Post-project	
DAD	Multiple best practices	2012	Any	SW development	Inception Construction Transition	Hybrid People and learning oriented

AGILE	Based on	Year	Size of projects	More suitable for / Industry	Lifecycle	Other considerations
XP Extreme Programming	Agile Manifesto	1999	small	SW development	Exploration Planning Iterations to Release Productionizing Maintenance Death	SW development methodology
TDD	Agile Manifesto	1999	Small to medium	SW development	N/A	Development strategy
Agile Modelling	Agile Manifesto	2000	small to medium	SW development	N/A	Modelling methodology

LEAN	Based on	Year	Size of projects	More suitable for / Industry	Lifecycle	Other considerations
Kanban	Lean production principles	Philosophy from 1940	small	Any	To do In progress Done	Limits work in progress Identifies bottlenecks
Scrumban	Agile Manifesto Lean production principles	Not known	small	SW development	Product backlog Sprint backlog Sprint Prototype	Hybrid Limits work in progress Identifies bottlenecks

2.7. Lost in the sea? Relocating methodologies...

Figure 17 is an effort to graphically synthesize and organize all the information given in the previous chapters so that a clearer comprehension of the field can be easily achieved.

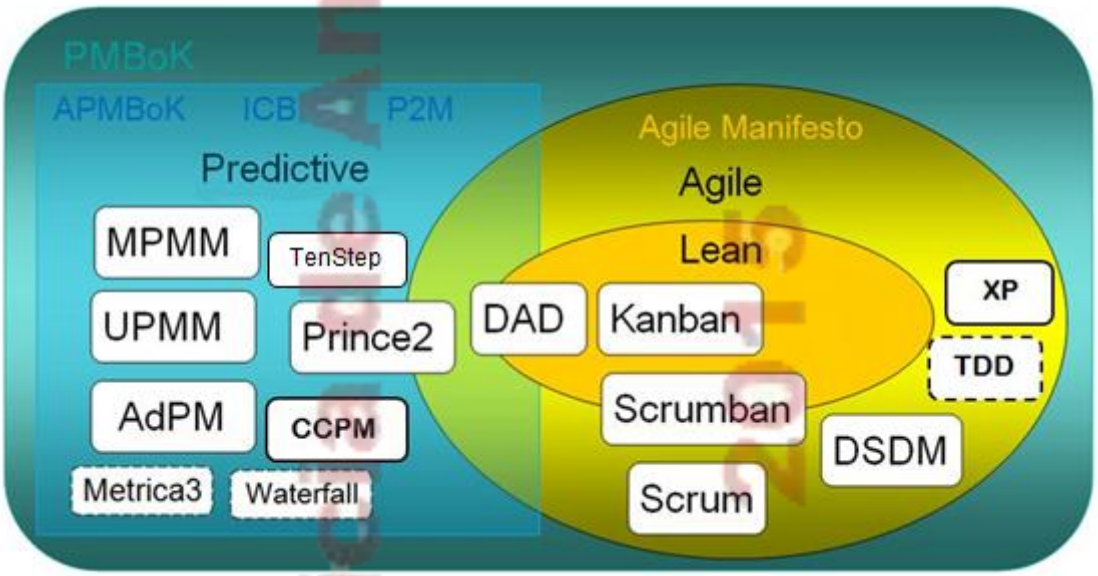


Figure 17 Project Management methodologies cartography [Original design]

In the image white notes represent methodologies while colored shapes represent approaches. Blue and square represents predictive, while oval and yellow represents agile.

The names of the different approaches are written in black. The names of bodies of knowledge and principles are written in color.

The shape of the boundary that represents the PMBOK is mostly square with round corners because PMBOK is mostly predictive but since its last version, which at this moment is version 5, it covers agile (or adaptive) issues as well. With the same idea in mind, it is also green with more blue than yellow. Again in the same way, Prince2 has been placed in between predictive and agile, with much more predictive part than agile part.

DAD tries to get the best of all approaches, and therefore it has gained a place in the middle of everything.

Lean is agile with some special characteristics, and so it is represented as a subset inside agile.

Finally white notes with discontinued boundaries do not represent Project Management methodologies but other methodologies related.

Chapter III: Applied Project Management

3.1. Telecommunication deployment features

In any telecommunication deployment we can distinguish two parts, with very different characteristics.

On one hand we find the physical parts, the hardware or infrastructure, commonly called “the iron” in the sector and on the other hand we find all the non-tangible elements: services, applications, configurations, parameters, protocols etc.

The deployment of a completely new service often involves the deployment of these two parts and the way to manage these deployments will vary depending on the specific characteristics of each part.

Both parts are not completely independent and a change in one of the parts might have an impact in the other.

Let’s have a look at the features of the deployment of a new application or non-tangible element:

- Need of a feasibility study: in this study issues such as compatibility with other systems or impact in other systems will be checked.
- Low initial investment.
- Low prototyping cost.
- Unstable requisites: the requester often does not exactly know what he/she wants or needs.
- Late change can add value to the final product

Whether the features of an infrastructure deployment are:

- Need of a feasibility study: In this case it is still more important to perform a feasibility study due to the high investment.
- Important initial investment.
- High prototyping cost.
- Stable requisites: The requisites are often defined by infrastructure architects that design the infrastructure to deploy regarding the service to which the new infrastructure will give support. The goal is always the service or the application and the infrastructure is only the means. The infrastructure has no sense without the service, and the service cannot be offered without the infrastructure that supports it.
- Subsequent changes are time-consuming and expensive.
- Several technical groups involved: This means that a huge coordination effort has to be made. A good quality documentation is a must in order to be able to maintain the system, to make the system evolve or simply to correct errors.

- Integration issues: New infrastructures often show problems when integrating with existing systems, once again there is a need to meticulously document every change made.

- The problems to solve are recurrent and their solutions well known and tested.

3.2. Choice of a methodology

The choice of a Project Management methodology is a complex question due to the many and heterogeneous factors involved. In the ideal case the methodology should meet the requirements of each individual project, thus having to make the choice for each project. But this is actually not a good idea for the effort and cost that a change of methodology implies.

Also a unique methodology might not address all the issues that need to be managed. Most organizations (up to 67% according to the PMI's Pulse of the Profession published in February 2014 [39]) decide to create their own methodology, usually based on a well-known methodology that they adapt to their needs.

Once the methodology is defined it will be used to manage each and (almost) every project in the organization maybe with minimal adaptations. This is so instead of choosing a methodology for each project because, as it has been already mentioned, there is important educational effort to do until every member of the organization gets to feel comfortable with the methodology.

Answering some questions can help us in way we choose a Project Management methodology.

Let's classify these questions in some categories:

Client related questions:

- Which is the priority for the client? Meeting deadlines or innovation and maximized value? Does he/she actually have a clear priority? Is the scope of the project well defined?
- In the same sense, how well defined are the requirements? Are clear and defined requirements provided?
- Which is the availability of the client? Will he/she be willing to work together with the project team?

Organizational and environmental questions:

- Which is the industry behind the product? Is there a specifically suited methodology for this industry? What type? Does the organization have an established Project Management methodology?
- Which are the characteristics of the organization in terms of maturity and culture of the organization in relation to Project Management?
- Should the methodology include processes that are specific to the organization or industry? Then the chosen methodology should include process integration.
- Are the projects homogeneous or very heterogeneous in terms of size? Is scalability of the methodology needed?

Project related questions:

- Which is the impact/cost of changes in the requirements?
- Which is the cost of prototyping?
- Which are the key aspects that will have to be controlled? At least time, cost and quality but also risk?
- Which is the criticality of the product to be developed?

Team and human resources questions:

- Which is the importance of communications for the project? Is the team physically distributed or close together?
- Which is the size of the project team?
- Which is the knowledge and expertise of the members of the team?

The decision of which methodology to use will heavily rely on the project manager knowledge on the field and his experience, as well as on the organization culture.

The following diagrams (Figure 18 and Figure 19) have been created in order to guide new project managers and experienced project managers willing to explore new paths of managing project in their decision of the methodology to use.

Here we can see depicted the questions we have proposed in relation with the predictive and agile approaches studied in 2.2. The color code (blue = predictive, yellow = agile) has been kept.

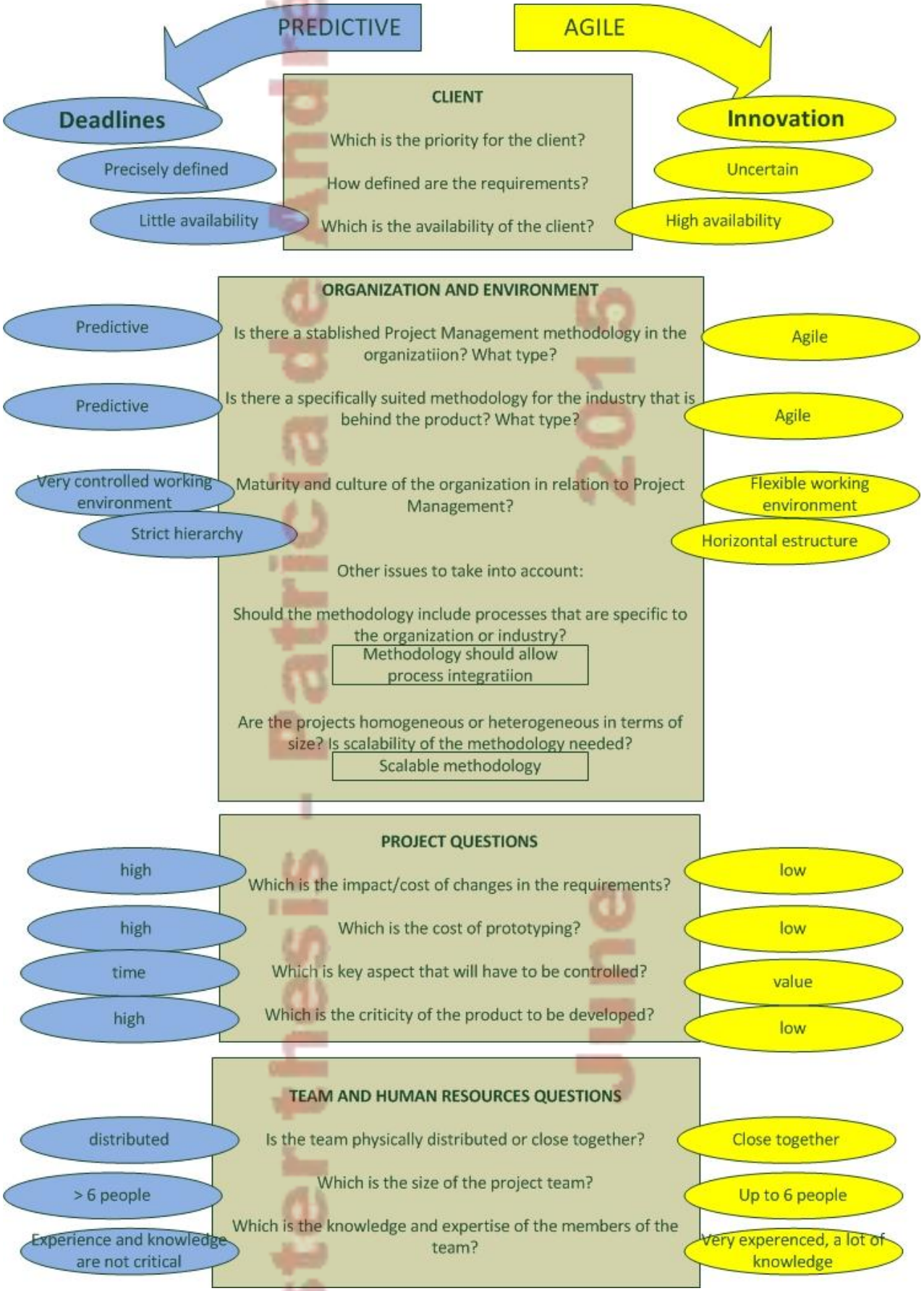


Figure 18 Choosing a Project Management methodology through questions [Original design]

Figure 19 is much more specific and tries to guide the selection of the methodology simplifying it a lot through the choices in a binary tree.

The studied methodologies have been included, as the end points of the tree.

Obviously this kind of selection should not be taken as the best selection possible for a given project because it is a very simplistic approach for a complex decision, but as a reference to make the Project Manager be aware of the suitability of a given methodology to manage a given project.

Most of the questions shown in the previous figure have been included in this diagram. It is easy to conclude that the predictive way of managing a project has a much bigger scope of application whether the agile way is constrained to very specific kind of projects. The benefits of its application in those cases are very important and this makes worth gaining knowledge in this kind of management.

But, how do we work with this diagram? With the features of a specific project and the characteristics of the organization to which the project belongs in mind we start at “Project” the top of the diagram and follow the arrows depending on the responses we give to the proposed questions.

Diamond boxes represent questions or choices, square boxes intermediate results and rounded boxes final results.

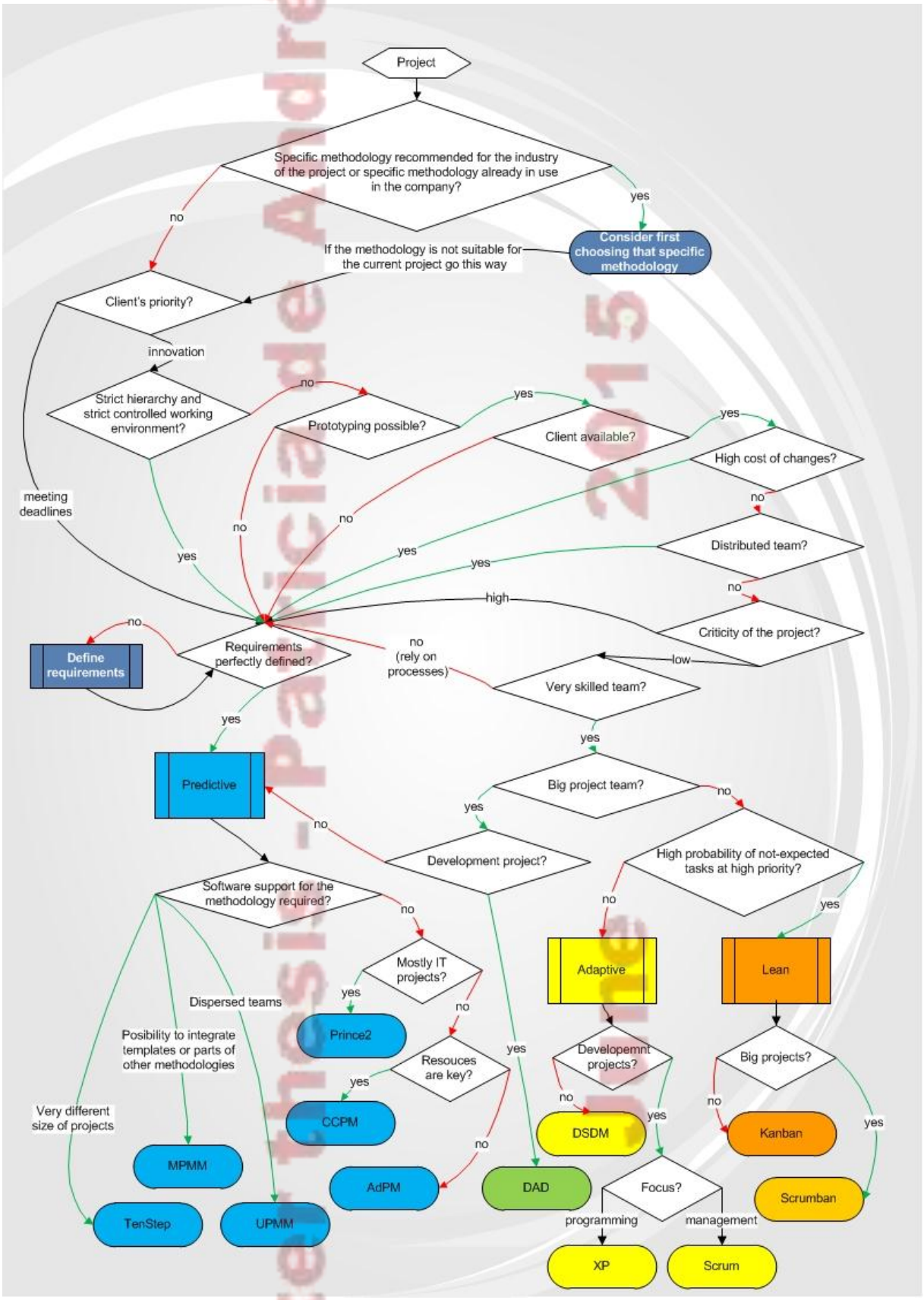


Figure 19 Choosing a Project Management methodology [Original design]

Obviously it is not reasonable for a Project Manager to know all of these methodologies nor is it feasible for a company to invest in all of them.

A good practice for a company would be to choose, depending in the characteristics of its projects, one predictive methodology and one agile methodology and take them as a basis for its Project Management strategy, as well as providing its employees the corresponding training in them so that the whole company can easily and accurately communicate in the same terms.

For sure the first project to be managed in a different way inside an organization will face the so known “resistance to change” of the organization and, at this point, it is very important to have a robust support of the high Direction of the company and a firm desire to implement a change in the culture of the company.

The Direction and the Project Manager that will be in charge of the first project to be performed this way need not to impose but to be prepared to show and convince the rest of employees of the benefits of working in an ordered manner and it is very important that this project will be successful to motivate the whole company to do the effort needed to learn a new way of working.

Chapter IV:
Case of study

We will put in practice what we have studied so far, and introduce a new way of managing projects, in the following case of study.

In this sense, we will use a different approach to the one commonly used, i.e. instead of choosing one methodology we will face the management of the project adjusting several of them to the specific characteristics of the case. More specifically the methodologies to use have to fit the parts that we can differentiate in the case thus optimizing the results obtained, and we will use some other methodologies for very specific points.

4.1. Introduction

A medium size company called ABC Inc. (150 employees), whose business is the maintenance of the information and telecommunications systems of its clients, has a central office with capacity for 40 people.

Most of the employees work from their homes and connect remotely to the infrastructures of their clients to watch the condition of the systems they maintain to detect problems, take actions or ask for the execution of the actions needed to immediately restore the service, distribute status reports punctually to their clients, etc.

The employees use portable computers to perform their activities and periodically return to the central office to keep their machines up to date (applications, software patches, antivirus, etc.)

This means that the computers are updated every two months more or less. The fact that there is so much time between updates has already resulted in unavailability of a portable computer as a consequence of a virus infection at a critical moment. Given this situation the employee has had to return urgently to the central office to get an updated and functional portable computer.

This company, whose business, as it has been mentioned before, is the maintenance of the information systems of other companies, has to pay fees when any of its employees cannot resolve a problem in the information or telecommunications systems of its client in the time agreed. Given the previous consideration it is very important that the computers are always in a good condition so that the incidents in the information systems of the client can be resolved within the deadline required.

Having this in mind the company has decided to set up a project whose aim is keeping up to date the computers used by all the employees and controlling the software installed in the computers remotely without the employees having to come periodically to the central office.

The name of this project is SYSMA (as it has been agreed by the High Direction and the Project Sponsor, see Figure 20. SYSMA is an acronym that stands for “System Maintenance”, that is part of the complete name of the project (System for the maintenance of the corporate portable computers).

There is no infrastructure available to support this new service so an infrastructure has to be built ad-hoc.

Given the prior description the following people is expected to take part in the project:

- Project Sponsor: This person plays the role of the client (the voice of the users) face to the project team that will undertake the project. This person is the interface to whom the questions about requirements will be addressed and he/she will also be responsible of validating the final result.

- Communications team: they design the way the elements of the IT infrastructure connect to each other, define IP ranges, etc.

- Infrastructure and software architects: they will design the solutions for the infrastructure and the development parts respectively. They collaborate with the system administrators and the communications teams.

- Computer security department: it will ensure that the designs of the software and infrastructure architect accomplish the security rules defined by the company.

- Developers' team: they will develop the application according to the design of the software architect.

- Systems team: they are in charge of the maintenance of the IT infrastructure, servers, firewalls, proxies... and of the deployment of the new infrastructure according to the design of the infrastructure architect.

- Testing team: it will confirm that the testing plan that will be provided by the development team is successfully completed and they will perform further tests if they consider that this is necessary. They will also check issues such as performance and security, following the instructions of the computer security department.

- Project Manager: the person that will plan the activities, control that they are accomplished on time and within the quality required, coordinate the project team and report to the Project Sponsor.

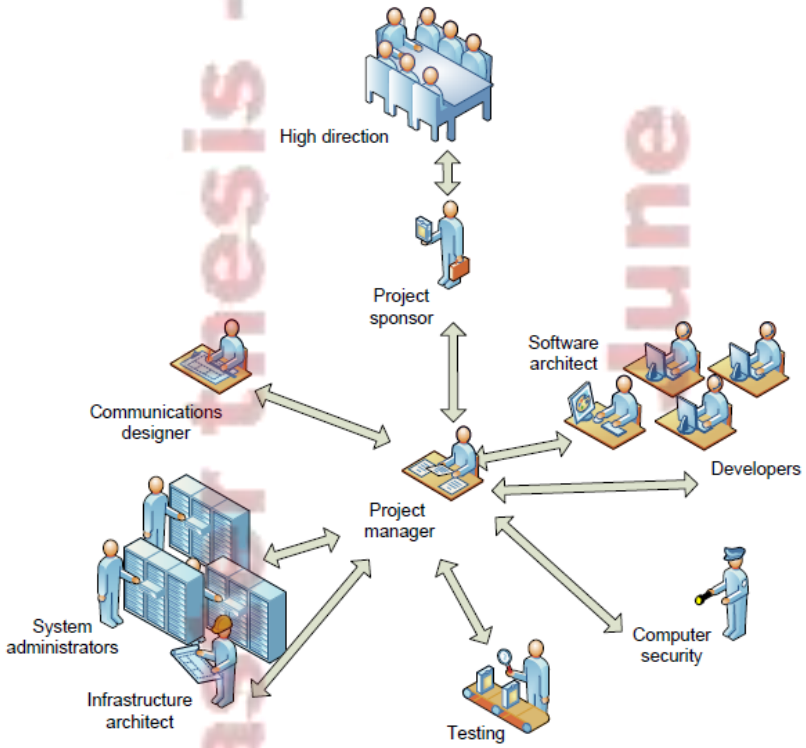


Figure 20 Project team [Original design]

4.2. Environment

To define the environment of the project we will answer the questions proposed in 3.2:

There will be some of the questions that the Project Manager can answer on his/her own, depending on his/her knowledge of the organization, and there will be other questions that will need the collaboration of other stakeholders such as the sponsor of the project, or even the technical teams. A couple of meetings with these stakeholders should be enough to gather this information.

Let's review the questions that should lead to the selection of a Project Management Methodology and take a look to the answers of the Project Manager in relation to ABC Inc and the SYSMA project.:

Organizational and environmental questions:

- Which is the industry behind the product? Is there a specifically suited methodology for this industry? What type? Does the organization have an established Project Management methodology?

  Telecommunication infrastructure and application development. Several methodologies of different types (predictive, agile, lean) are suitable for this industry. The organization has no established methodology so far.

- Which are the characteristics of the organization in terms of maturity and culture of the organization in relation to Project Management?

  The organization has no experience using Project Management methodologies but has become aware of the benefits of using one. The project manager has not either used a Project Management methodology before.

- Should the methodology include processes that are specific to the organization or industry? Given that case, the chosen methodology should include process integration.

  No specific processes are needed but it is desired to integrate processes from other methodologies.

- Are the projects homogeneous or very heterogeneous in terms of size? Is scalability of the methodology needed?

  There is no information concerning other projects.

Project related questions:

- Which is the impact/cost of changes in the requirements?

  Infrastructure → big impact

  Development → impact depends on the change

- Which is the cost of prototyping?

  Infrastructure → high cost, not possible!!

  Development → low cost

- Which are the key aspects that will have to be controlled? At least time, cost and quality but also risk?

  Yes, risk is also an important factor to our project because:

  a) *The criticality of the project (the new system has a direct impact in the business model of ABC Inc.)*
  b) *It has to be developed and deployed without or with the minimal service disruption.*

- Which is the criticality of the product to be developed?

  The project is important for the company business but it is not critical.

Team and human resources questions:

- Which is the importance of communications for the project? Is the team physically distributed or close together?

  The team is close together, it is not expected that the communications will be a major problem.

- Which is the size of the project team?

  About 15 people.

- Which is the knowledge and expertise of the members of the team?

  Most of the members are senior experienced technicians.

The following questions can only be answered after having the first meeting with the client or Project Sponsor. The conclusions or agreements that result as a consequence of this meeting (and the rest of meetings that will be held during the life of the project need to be documented in the form of a record of the meeting that has to be validated by all the attendants to the meeting).

Client related questions:

- Which is the priority for the client? Meeting deadlines or innovation and maximized value?

  The client does not have a clear priority. He has given a deadline for the basic functionalities but after those he wants the project to continue to get the maximum added value.

- Does the client actually have a clear priority?

  No

- Is the scope of the project well defined?

  No, the scope needs further definition in the application part.

- In the same sense, how well defined are the requirements? Are clear and defined requirements provided?

  They are clear for the basic functionality.

- Which is the availability of the client? Will he be willing to work together with the project team?

  Up to two hours per week. Good aptitude.

4.3. Methodology selection

Given the previous considerations about project management and the information gathered so far from the description of the case of study and the answers of the Project Manager about the project, it is easy to distinguish two well differentiated parts in the description of the case study: the development of an application that will fulfil the needs of the company and the deployment of an infrastructure that will support that application.

Considering the features of these two parts described in 3.2 it is clear that we have to choose at least one methodology with a predictive approach for the infrastructure part and it can be very interesting to choose one methodology with an agile approach for the development of the application.

Nevertheless both parts will be ideally carried out in parallel and will have some common parts and points of intersection like, for example, some of the meetings that will serve to get information about both aspects of the service and some of the testing that will be useful to verify the proper working of the application and assure that the infrastructure is right as well.

As there is no prior experience using a Project Management methodology a simplified software implementation of the methodology will be preferred so that its use will be as easy as possible.

A desirable feature of such software implementation is the possibility of integrating characteristics from other methodologies easily. This feature will be required in case we want to control aspects that are not considered in the methodology, that is, the possibility of adapting the methodology to our specific needs.

With these characteristics in mind we have a look at the diagram shown in 3.2 (Figure 18) and answer the questions proposed on it. Let's also see the particularization of the diagram of Figure 19 to our case of study below:

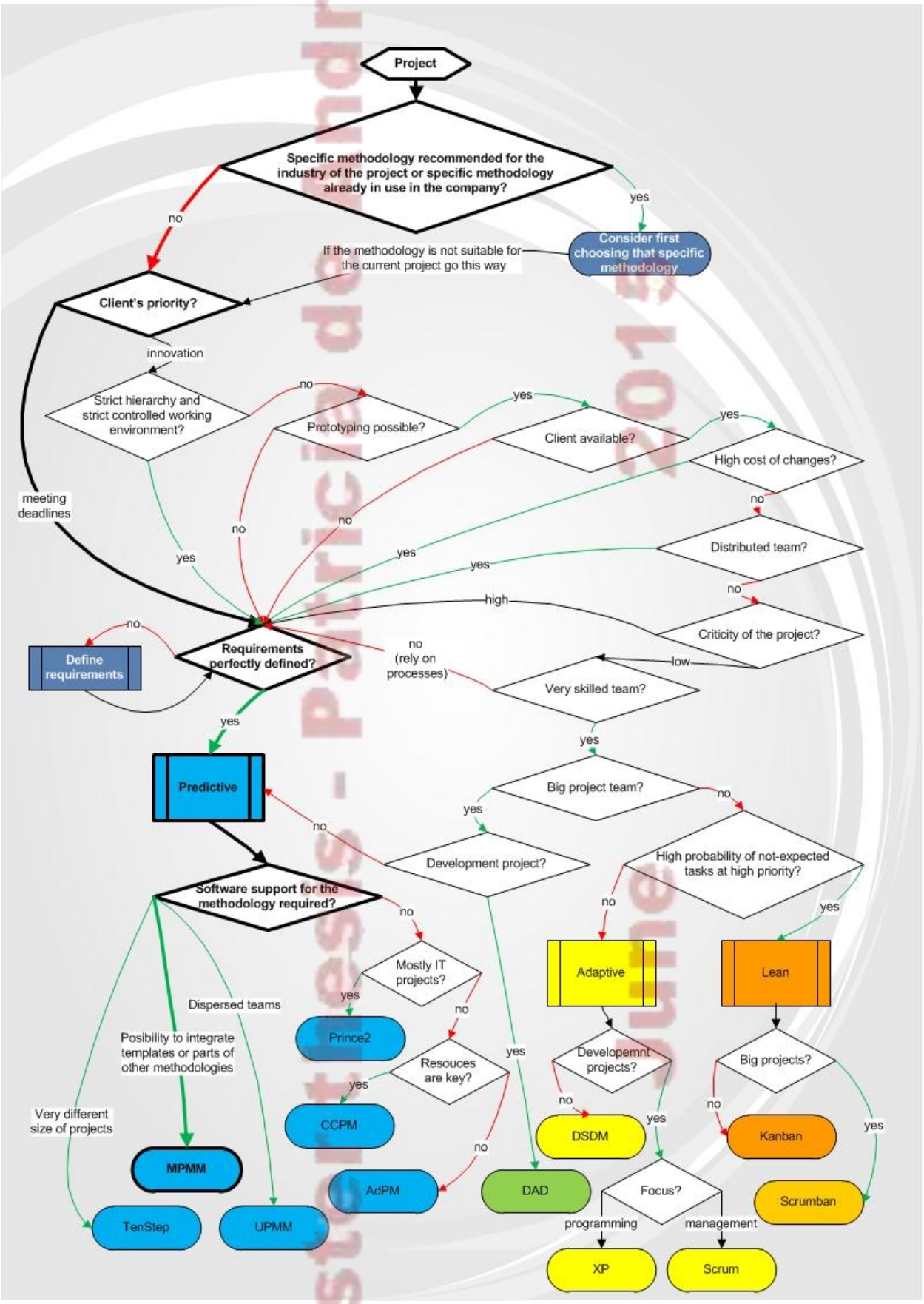


Figure 21 Methodology selection for the infrastructure part [Original design]

Even before the planning phase we can have a general idea of the major steps that we will follow to deploy our service.

We will have one unique project until a certain point, that (and we are anticipating the milestones diagram of the SYSMA project to show this circumstance) in our case is the third week of the project, as it can be seen in the following milestones diagram (see Figure 22).

After that week we will consider two well differentiated branches (one for the infrastructure and one for the software development) that will intersect in the milestones shown in red (later in this master thesis we will see the milestones of the two branches in more detail).

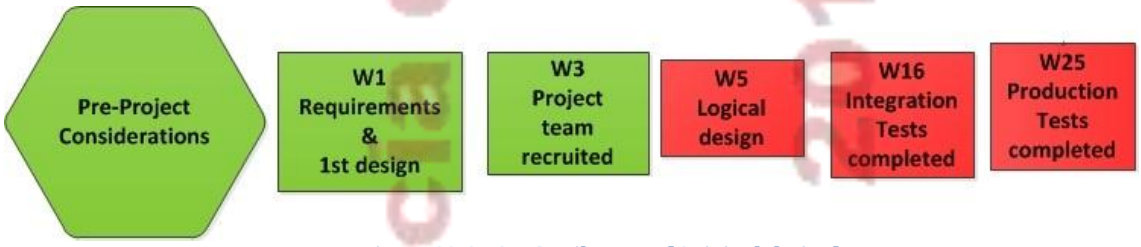


Figure 22 SYSMA milestones [Original design]

For the application part of the project we particularize the diagram of Figure 19 as well, but this time having in mind the characteristics of this part, and so we get to the conclusion that the Scrum methodology should be used as the basis for the management in this case. As expected the diagram has led us to an adaptive approach.

Among the different approaches Scrum seems to be the most suitable, because we are considering a software development project and between Extreme Programming and Scrum we decide to take Scrum because it gives support to do an holistic management of the issues that a project implies, not only the raw production of the software. This only means that Scrum will be the basis to manage the project not that we cannot profit from practices taken from other methodologies like, for example, the pair programming recommended by Extreme Programming for some critical parts of the software.

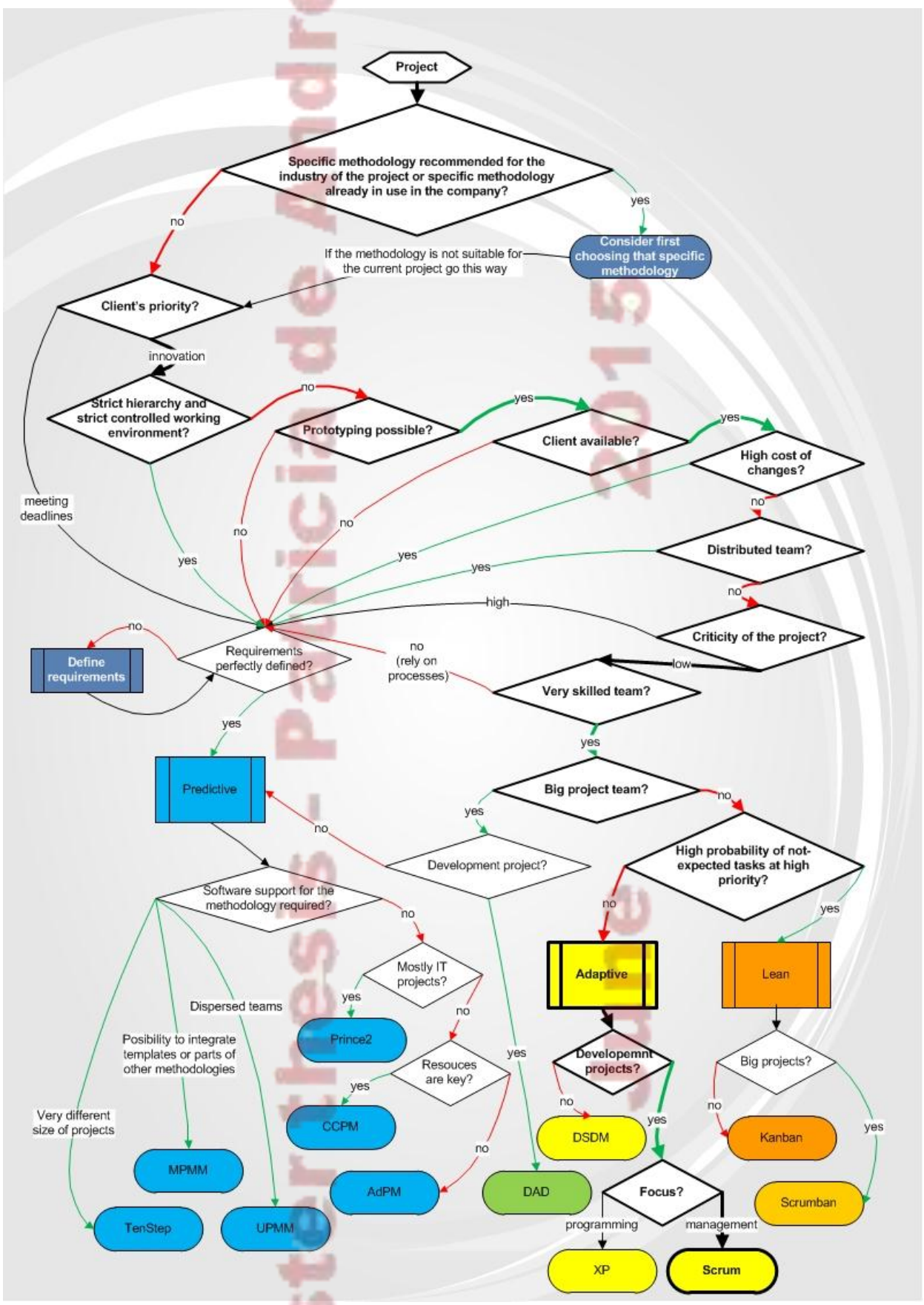


Figure 23 Methodology selection for the application part [Original design]

4.4. Pre-project considerations

MPMM provides guidance so that we can have an idea of which are the tasks to perform and which documentation would be adequate to our project depending on its size.

So the first thing to do is to determine the size of our project.

The methodology proposes three basic criteria for determining the overall project size, which are by order of relevance:

1. The estimated effort
   How many hours will it take to project completion? MPMM gives references in working hours, we will present the reference also in working days, weeks and months, considering days of 8 hours, weeks of 40 hours, and months of 160 hours.

Size	Effort in working hours	Effort in working days	Effort in working weeks	Effort in working months
Small	1-250	1-31	Up to 6	Up to 1,5
Medium	251-2500	31-312	6-62	1,5-15
Large	Over 2500	Over 312	Over 62	Over 15

   Regarding the previous table our project is classified in the medium size (if we estimate about 9 months until completion).

2. The experience of the Project Manager.
   The less experienced the Project Manager is, the bigger the size of the project will be estimated. The reason is that an inexperienced Project Manager will need much more guidance than an experienced one. We will consider a newbie Project Manager who has lead two small infrastructure projects before. He/she has not used any particular methodology and he/she has not leaded any development project before. Actually he/she is going to face his very first complex project so that the size in this sense is large.

3. The complexity and business criticality of the project.
   The project is not critical for the business. It is part of the global risks management and of the global strategy plans of the company. The improvement that results from the deployment of the new service will constitute a competitive advantage for the company. No impacts to other systems currently running in the company have been identified so far.

   The idea behind the project is quite complex, two parts (one of them development in which we will assume the Project Manager is completely new).

   Furthermore there is no experience in the company using a Project Management methodology. With these premises the project has quite a high probability of failure.

Fortunately, our brand new, novice and inexperienced Project Manager, aware of his limitations, has decided to make use of a Project Management methodology.

The Project Manager will not be required to consider financial issues, nor contacting directly the suppliers to negotiate the prices of the infrastructure that will be deployed or the prices of the software part (he/she will only need to prepare a viability or feasibility document that the Project Sponsor will send to the Purchasing Department to get the financial information).

The project will be classified as “medium sized” as a whole.

In general, the larger and the more complex the project is, the more structure and formality will be needed.

Now that we have categorized our project as medium sized its lifecycle can start. MPMM provides some guidance on which tasks should be undertaken for a medium sized project, nevertheless this is not absolutely mandatory, depending on the project and particular circumstances of the organization and context, there might be tasks that the Project Manager will decide not to do and, on the contrary, he/she might add some other tasks as well.

Let’s remember that the project lifecycle consists of four phases according to MPMM. For simplicity the following sections will be named in the same way as these four phases, that is Project Initiation, Project Planning, Project Execution and Project Closure.

4.5. Project Initiation (MPMM)

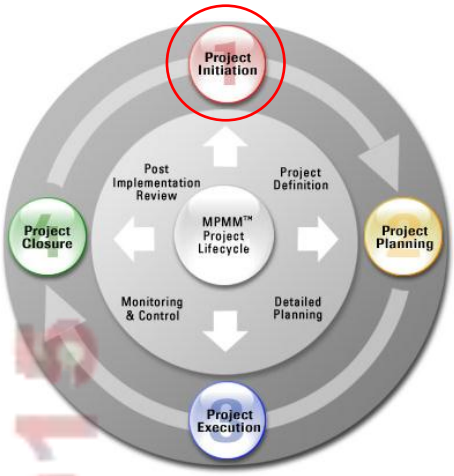


Figure 24 MPMM Initiation [21]

The early phases of projects (initiation and planning) are the most important to establish a good foundation for projects.

It is worth starting slowly and firmly and, if necessary, making a big inversion in doing so (in terms of time and money) than regretting the fatal consequences of not doing so.

Even if the project is cancelled just after the project initiation phase the inversion would have been worth it because the cancellation has surely been a consequence of aspects that have been detected in that phase. It is a thousand times better to detect the no feasibility of a project in the early phases than in the middle of the execution phase.

In the same way it is worth not to economize in resources at the initial phases but having the best and most experienced professionals available for the project so that the project can profit from their knowledge, experience and advice. Later when the project is well defined and in the right way to it completion other profiles less experienced can enter the project and expand their competences working on it.

According to the MPMM for a medium size project the following tasks must be performed in this phase:

- Develop a business case
- Establish the project charter
- Appoint the project team
- Set up the project office
- Perform a phase review

From the additional tasks that should be performed in the case of a large project we consider adequate also this one:

- Undertake a feasibility study

4.5.1. Develop a business case

The Project Manager receives the business case already completed through the Project Sponsor. It might be part of the Portfolio planning, which is an instance higher than the project (a portfolio is a group of projects).

For this part we will follow a different approach from that given by MPMM. For MPMM a business case is the analysis of a problem and its possible alternative solutions, and also includes the decision to take one of the alternatives, whether for this master thesis (and aligned with pure PRINCE2) a business case should be much more high level than that.

The aim of the business case is to allow the management to judge if a project is desirable, viable and achievable, that is, worth investing in it.

The information that the business case should contain is:

- Reasons for doing the project (is the project aligned with the strategic goals of the organization?)
- Requirements of the output of the project
- Cost and time high-level estimations
- Benefits and dis-benefits
- Overview of risks

The consideration of the detailed alternative solutions (and their feasibility) will come after this business case and will require the participation of the technical team. Nevertheless a first approach to the possible solutions will be done at this early stage with the collaboration of somebody with a technical profile.

It is a good practice to create a template for the business case and reuse it any time needed for the different projects of the organization. This kind of standardization of processes has the advantage that it minimizes the risk of forgetting important data. Surely the person who is working on the business case has this information in mind but it is important to generate a good documentation of the projects that will be available for consultation any time needed.

Another advantage of having a template for this purpose is that if the Project Manager is on holidays or absent from the office for any reason the time needed by a new person to catch up with the projects currently being developed is considerably reduced. The new person already knows the template so he/she can easily get any information he/she needs going directly to the part of the document concerned.

4.5.2. Feasibility study

Given the Business Case document, and further information obtained from the Project Sponsor, alternative solutions will be designed.

The solutions are typically created by the infrastructures and the applications architects and presented to a person from the integration team (a team dedicated to introduce new services in the company).

The integration team has high-level knowledge about everything already running in the company and can give advice on issues such as reutilization of infrastructure, potential risks or impacts in other applications of the company, etc.

Each of the alternative solutions will be well documented and their feasibility will be studied. Among the feasible solutions considered, there will be one identified as the preferred solution.

At this point an appointment with the Project Sponsor will be done so that the solutions will be presented to him and he will have the opportunity to ask any questions and doubts he might have to finally decide the solution to be implemented by the project.

In the case of the infrastructure part, if there is no chance for prototypes, the solution will be built in a predictive manner, while in the case of the application part the chosen solution will be taken as the start point to begin building functional prototypes with the collaboration of

the Project Sponsor. At the end a software product that meets the initial requirements and any other improvements that might have arisen in the process will be obtained, thus gaining an added value at the end.

The Feasibility study document for our case study is shown next.

Feasibility Study

A. General Information

Project Title:	System for the maintenance of the corporate portable computers	***Project Working Title:***	SYSMA
Project Manager:	Eira Woodham	***Project Sponsor:***	Halvard Adamsen
Project Client:	ABC Inc.	***Prepared By:***	Cristiano Mendoza - Inf Architect Elisabeth Spenger - SW Architect Spyros Iordanou - Systems expert Brett Pickle - Integration expert Eira Woodham – Project Manager

B. Project Overview

I. Project Objectives:
Remotely monitor the status (installed software and patches) of all portable computers that belong to ABC Inc. at least once every three days and keep all the portable computers up to date.

II. Purpose / Business Need:

Most of the employees in ABC Inc. work from their homes and connect remotely to the infrastructures of our clients to watch the condition of the systems they maintain.

The employees use portable computers to perform their activities and periodically return to the central office to keep their machines up to date (applications, software patches, etc.)

This means having an update every two months more or less which has already resulted in unavailability of a portable computer with several bad consequences for ABC Inc.

There is the business need of keeping up to date the equipment used by all the employees and controlling the software installed in the computers remotely without the employees having to come periodically to the central office.

There is no infrastructure available to support this new service so an infrastructure has to be built ad-hoc.

There are 2 environments to adapt and the aim is to have the system in Production in 9 months.

C. Project requisites

Changes to the original requisites must be signed by the parties and included in this section.

Products:

- Two independent infrastructures for the project are required (one in the integration environment and one in the production environment) with the following features:
  - Capacity of the integration environment: 30 users
  - Capacity of the production environment: 300 users
  - Response time in the integration environment: 1s
  - Response time in the production environment: 200ms
  - Application with the following functionalities::Automatic updates
  - Administration profile
  - Monitor status at least every three days (with exportable reports)
  - Web interface
  - Business is willing to hear proposals of other technically possible capabilities to get the maximum benefit of the new infrastructure.

Documentation:

- Detailed description of both environments.
- Exploitation manual for both environments.
- Minimal application description for exploitation, maintenance and further development.

D. Alternative Solutions

The following information should be included here for each of the solutions considered

Infrastructure part:

1st Alternative:

- Logical design
- Physical design (for the 2 environments)
- Assessment of the feasibility (description of the methods used to assess that the solution will meet all the requirements)
- Cost, time and resources needed
- Integration issues
- Risks
- Assumptions
- Issues (any relevant aspect that was not described before)

(The exact solutions are not among the objectives of this master thesis)

2nd Alternative:

- Same parts as for alternative 1.

Application part:

- Very high level approach to the solution (as it will be developed in the form of incremental prototypes). The aim is to assure that the infrastructure is adequate and that the minimal requirements can be developed in the time needed. Also an estimation of the cost of the minimal functionality will be presented.

ABC INC.

E. Feasibility ranking summary

Feasibility Criteria	1st Alternative	2nd Alternative	Application

Further considerations…

F. Recommended solution

The second alternative is the recommended solution because of the reasons exposed in part E.

Brett Pickle
Integration expert

Cristiano Mendoza
Infrastructures Architect

Elisabeth Stenger
Systems expert

Spyros Iordanou
Software Architect

G. Chosen solution

.

We agree with the recommendation of the technical team so the second alternative is the chosen solution to implement.

Halvard Adamsen
Project Sponsor

Eira Woodham
Project Manager

H. Appendices

Any other relevant information can be added or referred here

4.5.3. Establish the project charter

Herbert Hoover, the 31st President of the US, who was also a mining engineer, said: “About the time we can make ends meet, somebody moves the ends” so here we are trying to fix the ends to the ground with stone by means of the project charter, and more precisely by means of the scope that is a part of the project charter.

The scope statement is an agreement among the project team, the Project Sponsor and the key stakeholders.

Creating a project scope that is accurate and robust enough is essential to undertake a successful project. The scope helps in managing the requests for change that might arise during the project lifecycle and ensures that the project team and the customer share a common understanding of what the project will deliver.

The project charter is the formal document that describes the what, who and how of the project, i.e. what the project has to achieve (objective, scope and deliverables), who has an interest in it (stakeholders, roles and responsibilities) and how the project will be implemented (implementation approach and risks)

This document states the limits for undertaking the project and it must contain the information mentioned above and listed below for clarity:

- Objectives
- Scope
- Deliverables
- Stakeholders
- Roles
- Responsibilities
- Implementation approach
- Risks

To check if the objectives are well defined we can remember the SMART rule that tries to describe the characteristics of a well-defined objective.

Following the SMART rule, an objective must be:

- **S**pecific
- **M**easurable
- **A**ttainable
- **R**ealistic/Relevant
- **T**ime-bound

With the previous information in mind we complete the project charter for our project as follows:

ABC INC.

Project Charter

A. General Information

Project Title:	System for the maintenance of the corporate portable computers	***Project Working Title:***	SYSMA
Project Manager:	Eira Woodham	***Project Sponsor:***	Halvard Adamsen
Project Client:	ABC Inc.	***Prepared By:***	Eira Woodham

B. Project Overview

I. Project Objectives:
Remotely monitor the status (installed software and patches) of all portable computers that belong to ABC Inc. at least once every three days and keep all the portable computers up to date. Obtain exportable reports.

II. Purpose / Business Need:
Keeping up to date the equipment used by all the employees of ABC Inc. and controlling the software installed in the computers remotely without the employees having to come periodically to the central office.

The business need is to have the system in Production in 9 months.

III. Project Scope:
Deployment of the infrastructure detailed in the design document for each environment respecting the following requirements:

- Two independent infrastructures for the project are required (one in the integration environment and one in the production environment)
- Capacity of the integration environment: 30 users
- Capacity of the production environment: 300 users
- Response time in the integration environment: 1s
- Response time in the production environment: 200ms

Development of the application that will provide the service with the following requirements:

- Automatic updates
- Administration profile
- Monitor status at least every three days (with exportable reports)
- Web interface

Business is willing to hear proposals of other capabilities technically possible to get the

maximum benefit of the new infrastructure.

Logical design (See appendix A)
Physical design for the Integration environment (See appendix B)
Physical design for the Production environment (See appendix C)

Production of the following documentation:

- Detailed description of both environments including:
  - Logical design
  - Physical design
  - Names of the machines
  - Description of the machines (model, microprocessor...)
  - Physical situation of the machines represented on a map
  - Electrical power of the machines
  - Electrical positions to which the machines are connected
  - Positions of the connections for communications (communications map, including backup lines, connections to switches, routers and whatever elements the technical solution may contain)
  - IPs assigned

- Exploitation manual for both environments specifying
  - Periodical resets if needed
  - Identified errors and how to handle them
  - How to connect to the administration system

- Minimal application description for exploitation, maintenance and further development.
  Any other documentation or further details are excluded from the project scope.
  The maintenance of the infrastructure is excluded from this project.

IV. Stakeholders:
The Project Sponsor is the Director of the Business Unit of Remote Maintenance of ABC Inc.(Halvard Adamsen) and the Ownership belongs to ABC Inc.

The stakeholders are:

- All the employees that will be final users and benefit from SYSMA
- The Project Team that will undertake SYSMA until its completion
- The Integration Team that will assure the integration of SYSMA in the whole Integration and Production environments of ABC Inc.
- The Production Team that will be in charge of SYSMA after it enters Production.
- The Project Sponsor

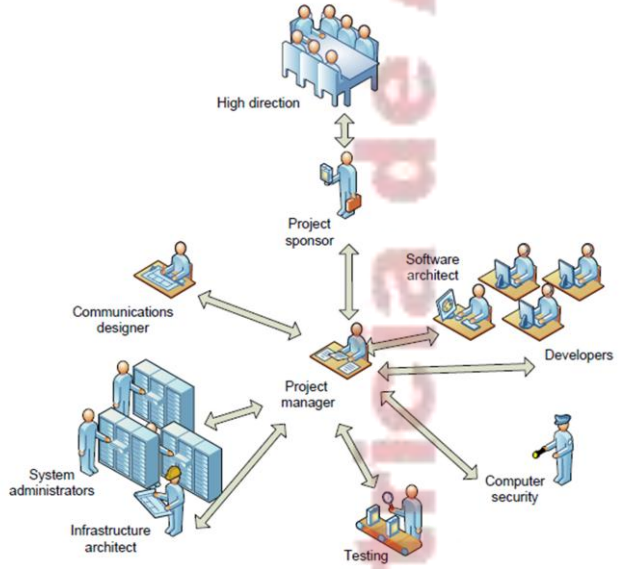
Please note that the application part will be developed applying the principles of the Scrum methodology, and therefore the implication of the Project Sponsor is required to provide feedback as part of the development team.

V. Roles and responsibilities of the project team:
Detailed in 4.5.4

ABC INC.

C. Project Approach Section

I. Organization and Responsibilities: (See 4.5.4 for the detailed responsibilities)



II. Reporting, Oversight, & Review: Reporting relationships and project interfaces should be described within this section. Identify required approvals and interfaces with organizations such as procurement. This is a summary of the Communications plan.

III. Dependencies: Any dependencies outside of the Project Manager's direct control, such as the delays from suppliers (they might be longer than agreed). This is closely related to the risks plan.

IV. Plans for Support Activities: Plans for project support activities are described here. Depending on the visibility we want to give outside the project we will include more information or not (for example we might include the quality plan or not).

V. Project Facilities and Resources: The project's requirements for facilities and resources are described here.

VI. Risk Management: Only major risks since we will have a specific risks plan.

VII. Project Schedule: A high-level schedule (milestones of the project.

VIII. Project Cost Estimate: This section outlines the estimated project cost

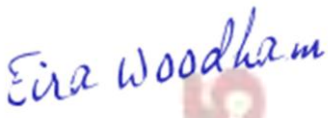
ABC INC.

D. Approval Section

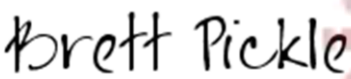
.

Signatures are included in this section.

Halvard Adamsen
Project Sponsor



Eira Woodham
Project Manager



Brett Pickle
Integration Team Director

Joyce Pettigrew
Production Team Director

E. Appendices

Changes to the original Project Charter must be signed by the parties and included in this section.

Here appendices A, B and C mentioned in the project scope should be included (the specific designs have no interest for the objectives of this master thesis)

Other appendices might include other documents like additional agreements.

4.5.4. Appoint the project team

With the details given in the business case the Project Manager has an idea of the technical team needed for the project. The team needed has to be documented in the project charter so that an estimation of the cost of the project is possible.

We show the detail here:

Project Role	Responsibilities	Number of candidates
Project Sponsor	• Give guidance on high level objectives • Validate the requirements, timetable, resources and budget • Validate the project plan and quality plan Chairing project board meetings • Validate the entrance of new resources and funds	1 Project Sponsor
Project Manager	• Control that the project is undertaken following the planning documentation • Producing deliverables on time within budget and to specification • Implementing management processes: time, cost, quality, change, risk, issue, procurement, communication and acceptance • Monitoring and reporting project performance: schedule, cost, quality and risk	1 Project Manager
Team member	• Undertaking all necessary tasks to produce the required deliverables • Keeping the Project Manager informed of the progress of the project • Raising all risks and issues as they become apparent • Maintaining all change, risk, issue, procurement, acceptance and communications registers throughout the project lifecycle	1 Infrastructures architect 1 Systems expert 1 Systems technician 1 Communications designer 2 Communications technicians 1 Computer security officer 1 Software architect 1 Designer 3 Software developers 1 Testing expert 1 Testing technician

We will not need all the members of the team for all the phases of the project, but it is important that they know about their participation in the project and that they are informed and engaged. They have to know when they are needed, what is expected from them and which are their responsibilities concerning the project.

We will suppose the human resources are available when needed and that we have written a document with all the team referenced by their names, roles, responsibilities and how to contact all of them (emails, telephone numbers, physical location, etc.) This type of document will be recurrently used during the life of the project and has to be up to date and available for all the team members.

What happens with the development team? (Scrum)

Since Scrum has been the methodology chosen to undertake the application part of the system the team members related to this part, that is :

1 Software architect
1 Designer
3 Software developers
1 Testing expert
1 Testing technician

merge into the Scrum team.

In the philosophy of Scrum, according to Ken Schwaber and Jeff Sutherland [32]:

> "Scrum teams are self-organizing and cross-functional. Self-organizing teams choose how best to accomplish their work, rather than being directed by others outside the team.
>
> Cross-functional teams have all competencies needed to accomplish the work without depending on others not part of the team. The team model in Scrum is designed to optimize flexibility, creativity, and productivity."

In other words: the staffing procedures will have to take into account the fact of using Scrum and so the staffing will be done in a different way from that of a predictive project. Self-organizing, cross-functional people will be the candidates to choose in order to set up the team.

The success of the project will rely much more on the people instead of relying on procedures as it is the case for the predictive part. The procedure to get a server working, for example, is well defined and there is no margin to innovate in that case, unless you working for the research department of a servers company. The developing team will consist of multidisciplinary people and not pure experts in any discipline. There will be no "project manager" either, as the team will be self-organized in order to maximize creativity, innovation, quality of the software and productivity.

We need to perform a change in the culture of the company to move from the situation shown on the left (Figure 26) to the situation on the right (Figure 25).

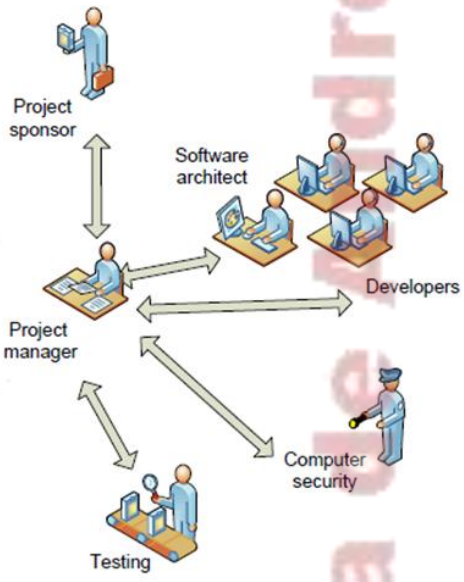


Figure 26 Traditional team [Original design]

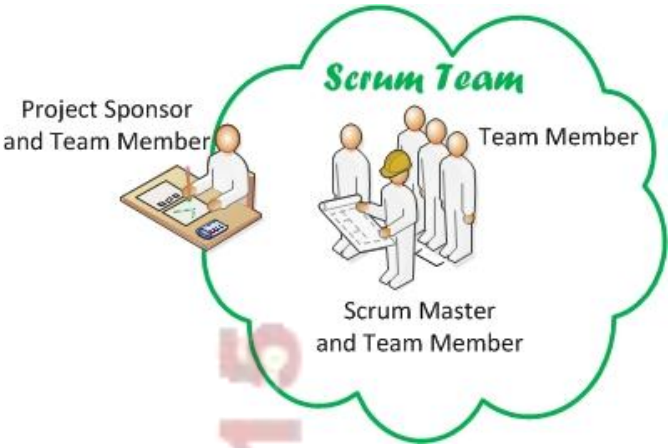


Figure 25 Scrum team [Original design]

We can distinguish three roles:

- Product Owner :
  He is the sole person responsible for managing the Product Backlog. He is responsible for maximizing the value of the product and the work of the Development Team. No one is allowed to tell the Development Team to work from a different set of requirements, and the Development Team isn't allowed to act on what anyone else says [32].

  Note that the Product Owner and the Project Sponsor are the same person!!

- Scrum Master :
  He is the responsible for ensuring Scrum is understood and enacted.
  Scrum Masters do this by ensuring that the Scrum Team adheres to Scrum theory, practices, and rules [32] He focuses on development and velocity. He is not a leader but a facilitator or problem solver, a kind of lubricant to make the Scrum team work better.

  The Project Manager executes managing processes, and asks for the execution of certain processes, tasks and operational activities as well. There is a hierarchy relation between the Project Manager and the Project Team.

  In contrast the Scrum Master warranties that the processes are correctly followed by the team, that all the meetings are held and have the defined duration etc. In Scrum all the processes are actually executed by the team itself at a whole in an horizontal structure. The Product Owner and the Scrum Master are just part of the team.

- Development Team
  It consists of professionals who do the work of delivering a potentially releasable Increment of "Done" product at the end of each sprint or iteration. As previously mentioned they are self-organized. No one (not even the Scrum Master) tells the Development Team how to turn Product Backlog into Increments of potentially releasable functionality. [32]

The roles topic in Scrum has raised a hot debate between the people who think that the Scrum Master is a Project Manager by another name and the people who think that it is a different role.

4.5.5. Set up the project office

MPMM considers this task among the initiation tasks of a medium size project. Nevertheless we will not. The reason is that the project office is out of the scope of a particular project.

The functions of a project office are, among others, to standardize processes for all the projects in the organization, perform program control (that is control of a set of related projects), allow new projects benefit from the lessons learned in completed projects, give support to Project Managers, identify synergies among different projects, distribute staff among projects to prevent surcharge risks, etc. As we can observe all these functions involve several projects, so it makes no sense to build a project office for each project.

The project office should be, depending on the organization and its needs, already be established, being the particular projects users or beneficiaries of it and having to report to it.

4.5.6. Perform a phase review

At this step we review the progress of the project up to date and, more specifically, we check that all the initiation tasks have been successfully completed.

The review is formally registered in the “Initiation phase review form”, and this document is presented to the Project Sponsor in order to get his authorization to proceed to the planning phase.

ABC INC.

Initiation Phase Review

A. General Information

Project Title:	System for the maintenance of the corporate portable computers	***Project Working Title:***	SYSMA
Project Manager:	Eira Woodham	***Project Sponsor:***	Halvard Adamsen
Project Client:	ABC Inc.	***Prepared By:***	Eira Woodham

B. Overall Status

Include a brief description of how the project is running

Project running as planned.

C. Initiation phase checklist

Topic	Issue	Status	Correct?	Comments
Schedule		Project charter compliant	Yes	
Cost		Project charter compliant	Yes	
Deliverables	Business case Feasibility study Project charter Project team	Done & validated Done & validated Done & validated Done & validated	Yes Yes Yes Yes	Documentation stored in //Projects/ongoing projects/SYSMA
Risks		No risks detected	Yes	
Changes		No changes	Yes	
Issues		No issues	Yes	

D. Detail of the deviations in schedule or cost.

More information if available

N/A

E. Detail of the changes, risks and issues detected

More information if available

N/A

ABC INC.

F. Approval section

Halvard Adamsen Project Sponsor	Eira Woodham Project Manager

4.6. Pre-game (or what the Scrum team is doing meanwhile)

Just like in the case of the infrastructure part the diagram below (Figure 27) shows where we are with respect to the life cycle of the project. We will use it to situate ourselves along the different phases.

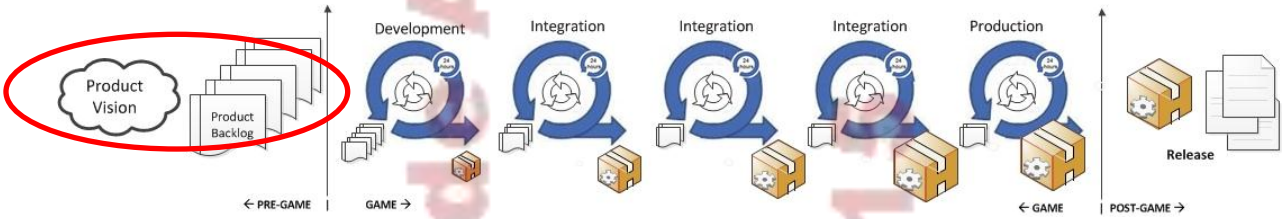


Figure 27 Scrum Pre-game [Original design]

Let's remember that we call Pre-game to the first of the phases defined by the Scrum methodology (see 2.5.2).

This is not one of the phases defined by MPMM but, as the title says, these paragraphs describe the activities that the Scrum team is doing while the rest of the people working in the infrastructure part is performing their tasks. It is hard to describe activities happening at the same time, in parallel branches of execution that sometimes converge on a linear support like this paper. To clarify this we will use the following graph and the milestones graphs that we will see later in the corresponding phase.

The color code has been kept so that blue refers to the predictive part (the infrastructure) and yellow refers to the adaptive part (the application), while green is common to both parts.

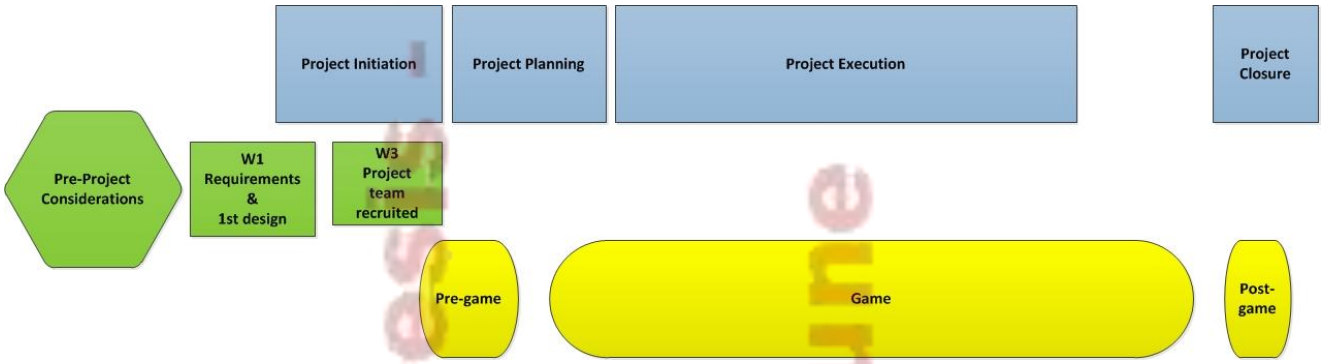


Figure 28 Predictive and adaptive phases [Original design]

In this representation we observe that the pre-game phase is at the same time under the Project Initiation and the Project Planning phases, because of the type of activities that it includes, while having much shorter duration than both of them. This makes it possible for the Game phase to start earlier than the Project Execution Phase.

The Scrum methodology is focused in the Product, or more precisely and somehow redundant expressed "in the production of the Product". However the Game phase is composed of iterations or sprints that include complete development cycles.

The Post-game corresponds to the Project Closure, and it is also much shorter in time that its predictive counterpart.

The Pre-game phase has two parts (Planning and System architecture/High level design) that we study in the next paragraphs.

4.6.1. Planning

In the Planning the following issues have to be covered:

- Stablish the product vision
- Determine its feasibility
- Create an initial product backlog
- Choose sprint length
- Estimate resources and cost
- Identify risks

Note that most of these activities (those concerning the product vision, feasibility, estimation of resources and cost and risk identification) have been done together with the predictive part in the Project Initiation Phase, thus considering the Project as a whole. Anyway, the estimation of resources and costs, as well as feasibility and risk identification need to be reviewed once the Scrum Team is stablished and any estimation

Given the previous consideration we still have to create an initial Product Backlog and choose a sprint length.

A Product Backlog is an ordered list of everything that might be needed in the Product and is the single source of requirements for any changes to be made to the Product. The Product Owner is responsible for the Product Backlog, including its content, availability and ordering [32]. Nevertheless the Product Owner can always ask for the advice of the Scrum Team for making his decisions.

For creating the Product Backlog the Scrum Team does not need to start from zero. In this case it can take the Project Charter produced in 4.5.3 as a start point to create and prioritize the Product backlog together with the Product Owner.

Let's remember the application requirements that had been listed in the Project Charter;

- Automatic updates
- Administration profile
- Monitor status at least every three days (with exportable reports)
- Web interface

Also the business had expressed his desire to hear proposals of other capabilities technically possible to get the maximum benefit of the new infrastructure.

This is how the Product Backlog of the SYSMA project looks like:

ID	Name	Priority	Initial estimate (days)	HowTo for testing	Comments
1	Automatic updates	10	12	Configure an update over a group of computers in the parameters sheet. Check that the update has been done as planned.	
2	Administration profile	6	21	Enter menu of the system. Configure a computer profile. Configure an automatic update. Modify a computer profile. Delete a computer profile. Modify an automatic update. Delete an automatic update	
3	Monitor status at least every three days (with exportable reports)	8	6	Check that a report is exported every three days from the start date of the system	It can easily be made configurable.
4	Web interface	3			
5	Basic web based instant messaging	1			

Note that there is one added item. The team has proposed to make the most of the web server that has to be installed and include a basic web instant messaging tool that will allow the technicians to interact with each other when developing their daily work. The Product Owner agreed but assigned the lowest priority to the feature, that is, it will be included in this release only if all other features have been achieved.

Scrum does not tell which information the Product Backlog should include. The team is free to choose the more convenient for each case. The Product Backlog is dynamic, it evolves as the Product itself evolves or, in very innovative environments, as the environment of the product evolves.

A length of the sprints from 2 to 4 weeks can be chosen, depending on several factors like the capacity of the team to produce, the size of the completed functionalities to be delivered, the likelihood of the Product Owner to introduce changes, the experience fo the members of the team, etc.

In this case we will suppose that a four weeks sprint has been chosen.

4.6.2. System architecture/High level design

Once the Product Backlog has been completed, the general architecture and high level design of the system can be produced by the Scrum Team, as a basis to start the development of the agreed solution. The specific design of the system is out of the scope of this master thesis and for this reason it is not further discussed.

4.7. Project Planning (MPMM)

According to MPMM the following tasks must be performed in this phase:

- Create a project plan
- Create a quality plan
- Create a risk plan
- Create a communications plan
- Contract suppliers
- Perform a phase review

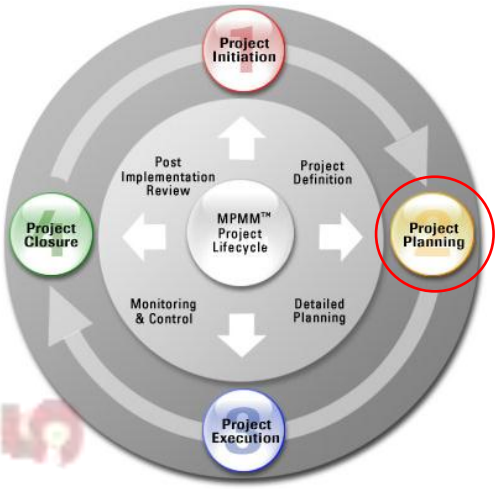


Figure 29 MPMM Planning [21]

From the additional tasks that should be performed in the case of a large project we consider adequate also this one:

- Create an acceptance plan

4.7.1. Create a project plan

The project plan is the pattern to which we compare the performance of the project in order to assess the project's time performance.

It is a complete list of the activities that must be done to complete the project and their dependencies with an estimation of the time that these activities should take. It also includes the milestones, resources and deadlines for all the activities.

Before writing the project plan it is very helpful to draw a Work Breakdown Structure (WBS).

This is a graphical representation of the decomposition of the project into its phases and tasks inside a phase. It can be decomposed as much as wanted or needed so that it is easier to keep the project under control and assign responsibilities.

The aim of the Work Breakdown Structure is to visualize the project and the possible tasks missing, to order the ideas related to what to do in the brain of the Project Manager. It is also a good tool to show the project team the work that the project consists of.

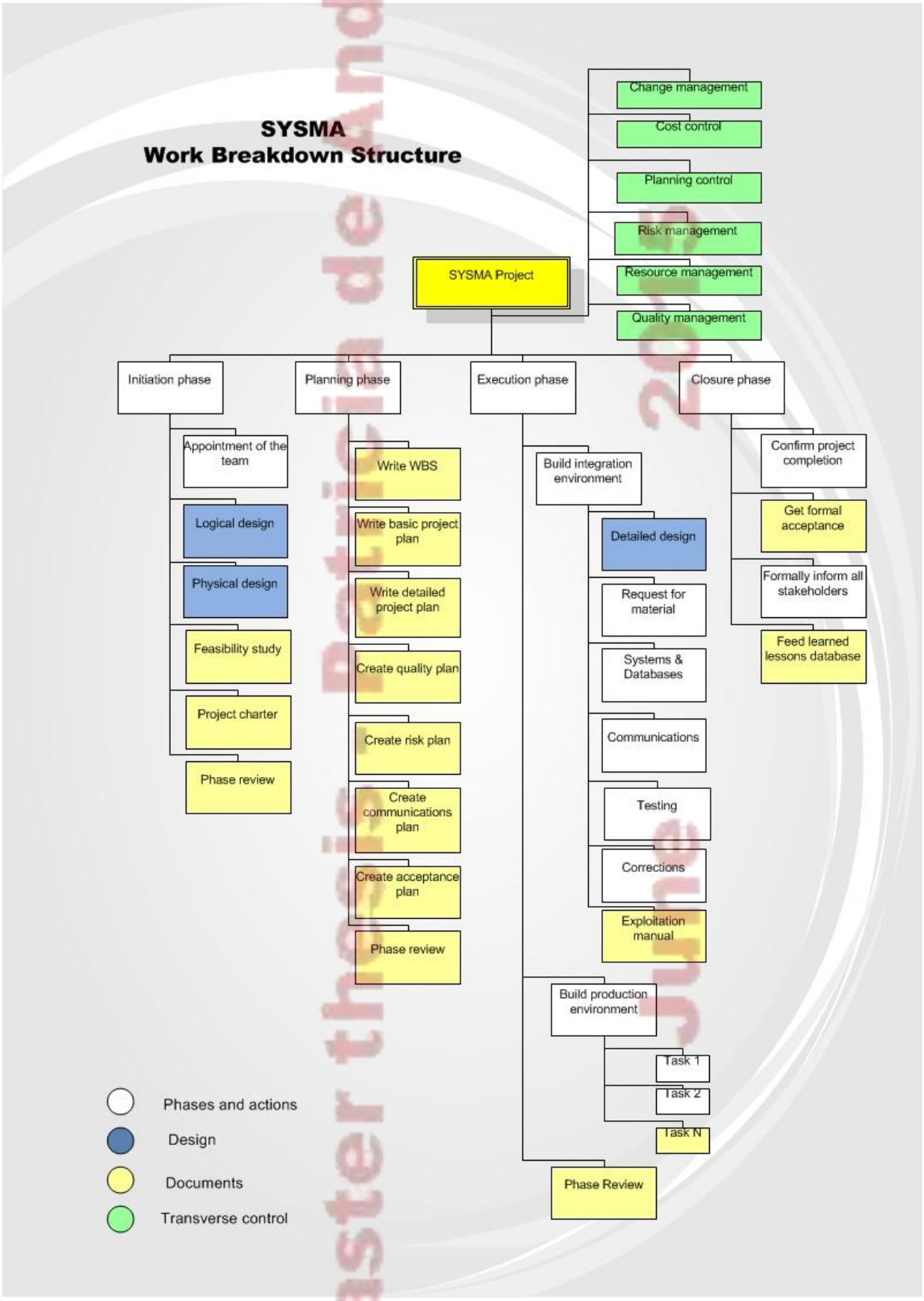


Figure 30 SYSMA Work Breakdown Structure [Original design]

The project plan must be done by the whole project team and every member must be engaged and aware of his role and contribution to the project.

Usually the Project Manager prepares a basic project plan and sends it to the whole project team so that they can study and prepare their activities (they might need, for example, to perform studies to determine the capacity and power of the machines that will be used etc, check if there is enough physical space and plugs to connect the new infrastructure, etc.).

To create this kind of planning it is extremely useful to integrate the techniques used in the Critical Chain Project Methodology (CCPM) (see 2.5.1.3). In our case of study we are considering an isolated project in the universe, but reality tells us that the resources are commonly assigned to multiple projects at a time to avoid the "empty periods", that is periods in which the resources have to wait for another dependencies to occur and cannot go on with their activities.

If we look carefully at the milestones diagram depicted at the end of this section (Figure 32) it is easy to find this empty time, but the multitasking is usually excessive and project managers find themselves fighting for the resources. By means of critical chain techniques this issue can be addressed by organizing the tasks so that we can do a proper use of the resources and still deliver on the time required.

The Project Manager will appoint a meeting in which the project team can share any doubt and finally, if everything is clear, the project plan will be completed and validated by the project team.

To illustrate how a project plan looks like, we include a project plan of the communications part in the Production environment (Figure 31).

	Nombre de tarea	Duración	Comienzo	Fin	Predecesoras	Nombres de los recursos
3	**Communications in the Production Environment**	**8 días**	**mié 26/11/14**	**vie 05/12/14**		
4	Design communications map	3 días	mié 26/11/14	vie 28/11/14		Comms. Team
5	Design of IP plan	1 día	lun 01/12/14	lun 01/12/14	4	Comms. Team
6	Assign Ips	2 días	mié 03/12/14	jue 04/12/14	14;5	Comms. Team
7	Configure direct connection to machines	1 día	vie 05/12/14	vie 05/12/14	6	Comms. Team
8	Configure backup connection to machines	1 día	vie 05/12/14	vie 05/12/14	6	Comms. Team
9	Configure FW to access Control-M	1 día	vie 05/12/14	vie 05/12/14	6	Comms. Team
10	Configure FW for the IIS	1 día	vie 05/12/14	vie 05/12/14	6	Comms. Team
11	Configure switches to reach the IIS	1 día	vie 05/12/14	vie 05/12/14	6	Comms. Team
12						
13						
14	**Systems in the Production Environment**	**4 días**	**jue 27/11/14**	**mar 02/12/14**		
15	Placement of machines in the CPD	1 día	jue 27/11/14	jue 27/11/14		Systems team
16	Wiring of the machines	2 días	vie 28/11/14	lun 01/12/14	15	Systems team

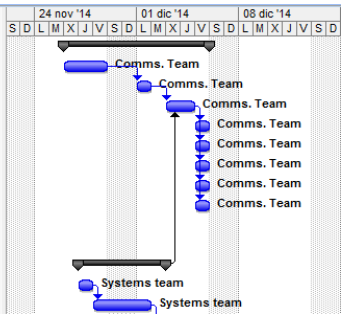


Figure 31 SYSMA Communications planning [Original figure]

Notice that the project plan is also the resources plan. It can be written at a "team level", i.e. mentioning the team who is in charge of every task and giving freedom to the team to organize itself or at a "person level" that is directly assigning each of the tasks to a person or resource.

Not only to gain the commitment of the project team, but also to make realistic estimations, it is crucial to make the estimations with its agreement.

The project plan helps the Project Manager to identify any task slippage.

The project plan must clearly define the milestones of the project but, as it is quite difficult to include in these pages a complete project plan, and it is also not the goal of this master thesis to create a complete project plan we will use Figure 32 to depict the milestones. This type of diagram is helpful for the Project Manager to explain the general plan to the Project Sponsor, for example, so that he can get a better idea how the project will evolve in time.

A milestone is an important event in the project, or the different goals we have to achieve in a consecutive manner to get the project done.

In this graph “W” means “week”, for example “W12” represents the last day of the twelfth week after the project started.

The milestones that are important for the Development part have been highlighted in red.

The red arrow contains the message “Deadline for feedback from the development part”.

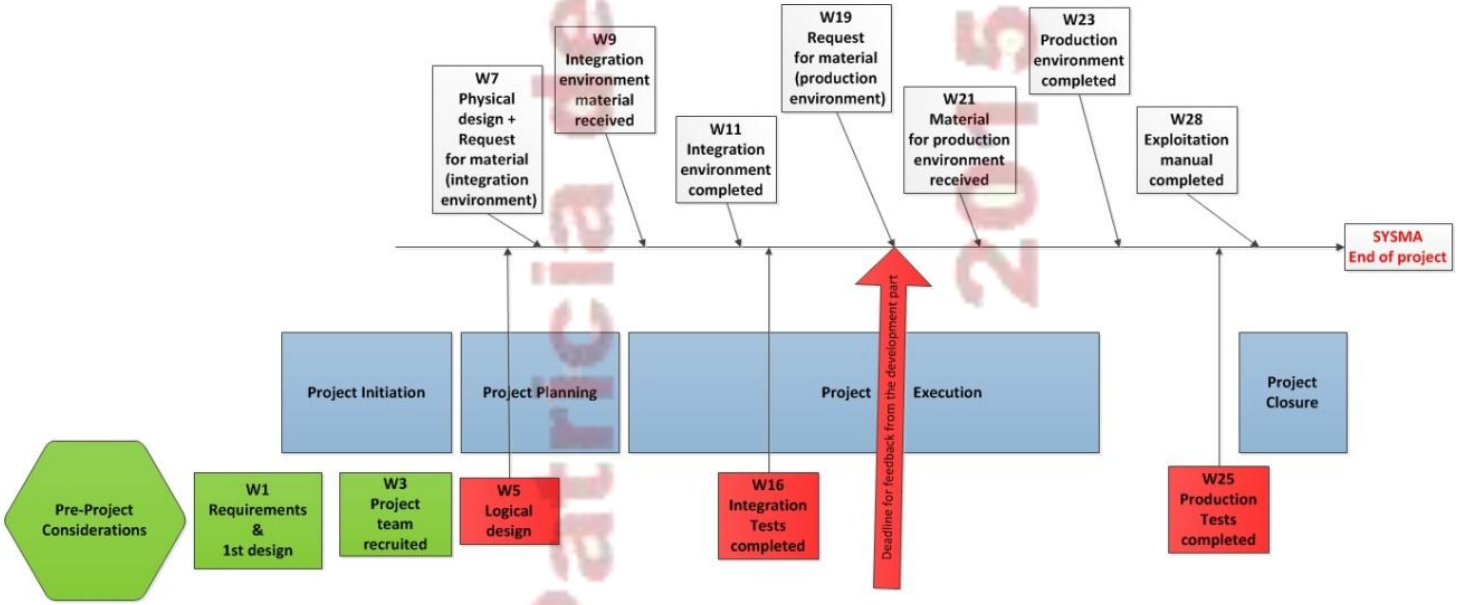


Figure 32 SYSMA Milestones [Original design]

4.7.2. Create a quality plan

The quality of the deliverables is a determinant factor of the success or failure of an organization.

But, what is quality in our project? The first task to undertake is to clearly define what quality means for our project. MPMM proposes to measure quality in terms of the requirements of the project. To which extent are these requirements satisfied? This exactly will be the measure of our quality. The quality plan has to include the quality of our process management processes as well. Process management can be considered as a “non tangible” product of our project. The criteria to measure this is to be defined.

Usually projects managers struggle to define quality plans, they face clients who (surprisingly) are not interested in hearing about quality plans and the underlying reason for this, which is the real big problem, is that in order to define a quality plan you need to clearly define the requirements of your project. A lot of clients do not really know what they want or need so they are not willing to engage themselves to a given list of requirements.

So, we check the fixed requirements in our project charter and search for quality criteria.

A detailed testing plan has to be created by the project team, and this testing plan has to be validated by the customer.

The quality plan will contain the following information:

1) List of requirements of our project and criteria to measure their quality.

2) List of our project management processes and criteria to measure their quality.

3) Actions to assure that the required quality is achieved.

For the list of requirements of our project we can refer to the list stablished in the project charter.4.5.3. Note that we are including here only quality considerations concerning the infrastructure part because we consider that the quality related to the application part will highly rely on the Product Owner that will have the opportunity (and the obligation) to check the quality of the application at least at the end of each sprint.

Next the Quality Plan for the SYSMA project is shown. It can be kept to be used in an internal way or it can be shown to the Project Sponsor. For our case of study we will consider that it is kept inside the project so it will not be signed by the Project Sponsor but only by the people that have produced it.

The fourth requirement of the category “Management Processes” is an adaptation to a distributed team of the Daily Scrum meeting (check 4.8 for more information on this kind of meeting). The team working in the infrastructure part will typically be placed next to the machines rooms so it is not practical to make them travel to meet every day but it is a very worth information for the Project Manager to daily measure the “temperature” of the project.

ABC INC.

Quality Plan

A. General Information

Project Title:	System for the maintenance of the corporate portable computers	***Project Working Title:***	SYSMA
Project Manager:	Eira Woodham	***Project Sponsor:***	Halvard Adamsen
Project Client:	ABC Inc.	***Prepared By:***	Cristiano Mendoza - Inf Architect Elisabeth Spenger - SW Architect Spyros Iordanou - Systems expert Brett Pickle - Integration expert Eira Woodham – Project Manager

B. Quality Requirements, criteria and assurance actions

I. Deployment Requirements:

Requirement:

Two independent infrastructures for the project are required (one in the integration environment and one in the production environment).

Criteria:

Tests OK.

Assurance Plan:

A testing plan will be done to assure the independence of both infrastructures.

II. Capacity Requirements:

Requirement 1:

Capacity of the integration environment: 30 users.
Capacity of the production environment: 300 users.

Criteria:

Tests OK.

Assurance Plan:

A testing including simulation of users will be passed.

III. Performance Requirements:

Requirement:

Response time in the integration environment: 1s.

Response time in the production environment: 200ms.

Criteria:

Tests OK.

Assurance Plan:

A testing plan including stress tests will be done.

IV. Documentation Requirements:

Requirement 1:

Detailed description of both environments.

Criteria:

The description must include the following information:

- Logical design
- Physical design
- Names of the machines
- Description of the machines (model, microprocessor...)
- Physical situation of the machines represented on a map
- Electrical power of the machines
- Electrical positions to which the machines are connected
- Positions of the connections for communications (communications map, including backup lines, connections to switches, routers and whatever elements the technical solution may contain).
- IPs assigned

Assurance Plan:

Double validation of the documentation by the Project Manager and one person from the maintenance team to which the infrastructure will be transferred.

Requirement 2:

Exploitation manual for both environments

Criteria:

The manuals have to include the following information:

- Periodical resets if needed
- Identified errors and how to handle them
- How to connect to the administration system

Assurance Plan:

Double validation of the documentation by the Project Manager and one person from the maintenance team to which the infrastructure will be transferred.

V. Management Processes:

Requirement 1:
Formal review at the end of each phase.

Criteria:
The corresponding documents will be stored at
//Projects/ongoing projects/SYSMA/<phase>/docs/review

Assurance Plan:
The Project Sponsor will be asked to take the action of checking this.

Requirement 2:
Monthly meetings with the Project Sponsor .

Criteria:
The memoranda of the meetings will be sent by email to the attendees and they will be stored at
//Projects/ongoing projects/SYSMA/memoranda/monthly

Assurance Plan:
The meetings will be scheduled and the invitations will be sent in advance. The Project Sponsor will be asked to take the action of checking this.

Requirement 3:
Weekly global meeting to review overall status.

Criteria: The memoranda of the meetings will be sent by email to the attendees and they will be stored at
//Projects/ongoing projects/SYSMA/memoranda/weekly

Assurance Plan:
The meetings will be scheduled and the invitations will be sent in advance One attendee will receive the assignment of writing the memorandum at each meeting and another the assignment of

Requirement 4:
Perform a morning check. A daily pooling by telephone will be done by the Project Manager to all the departments working in the project to detect any blocking issues that might endanger the accomplishment of

the objectives of the project.

ABC INC.

Criteria:
A checklist will be completed with OK/KO and the blocking circumstances that justify the KO. It will be stored and shared with all the team at //Projects/ongoing projects/SYSMA/memoranda/daily

I. Signatures section

Brett Pickle
Integration expert

Cristiano Mendoza
Infrastructures Architect

Elisabeth Stenger
Systems expert

Spyros Iordanou
Software Architect

Eira Woodham
Project Manager

J. Appendices

Any other relevant information can be added or referred here

Here all the mentioned testing documents have to be included.

4.7.3. Create a risk plan

A risk plan identifies all the risks that can be predicted in advance and describes the actions that need to be done in order to prevent the risk from happening and to minimize the impact in the project in the case that the identified risk might occur.

We call risk to any circumstance that could endanger the ability of the project to meet its defined objectives.

The preventive actions are those that are intended to minimize the probability of the risk to happen and the contingent actions are those intended to minimize the impact once the risk has actually happened.

It is important to evaluate the probability of a risk to occur and its impact in that case, to adapt our actions to both parameters. It is also a must to include in the plan when we will review the risks so that we end up with a real risks plan.

The cost of the preventive and contingent actions must be lower than the cost that the project would have to face if the project did not have a risk plan defined at all, that is it must be worth having a risk plan.

It is useful to build this plan in an Excel sheet format, to make it more dynamic and easy to update.

Let's take a look at a possible format for the SYSMA project:

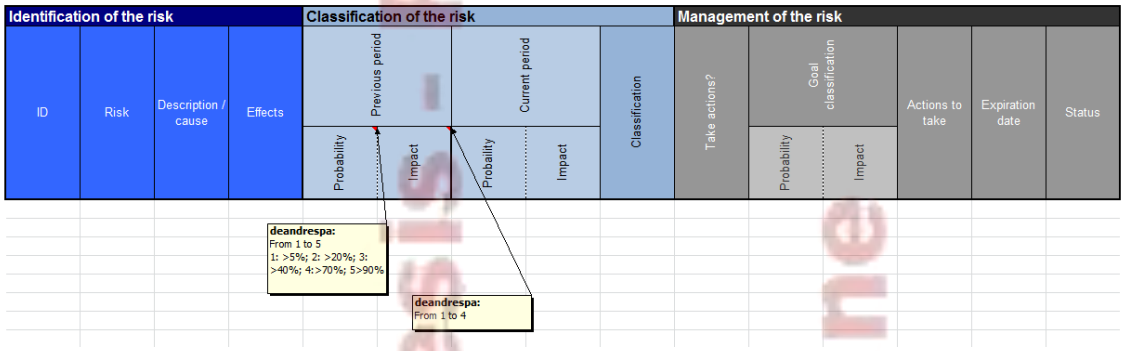


Figure 33 Risk plan [Original figure]

The first group of columns identifies without ambiguity the risk. A unique ID is assigned so that it can be used to talk about the specific risk any time needed.

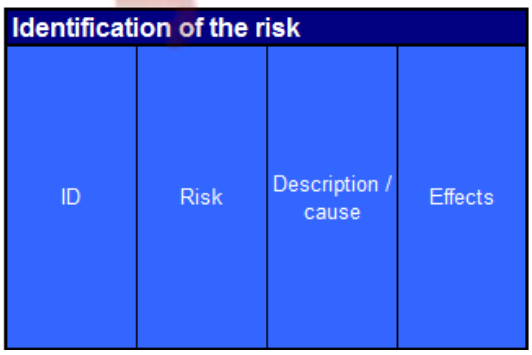


Figure 34 Detail of risk plan – Identification [Original figure]

The probability and impact of a risk is different depending on time. The second group of columns contains information about the probability and impact of each identified in the previous period and the current period.

Taking into account these two values we can assess a classification of the risk. This classification makes it possible to compare different risks and always refers to the current period.

If we want to keep a record of the evolution of the risks in time to enrich the knowledge on the topic in our organization we can add as many columns as periods.

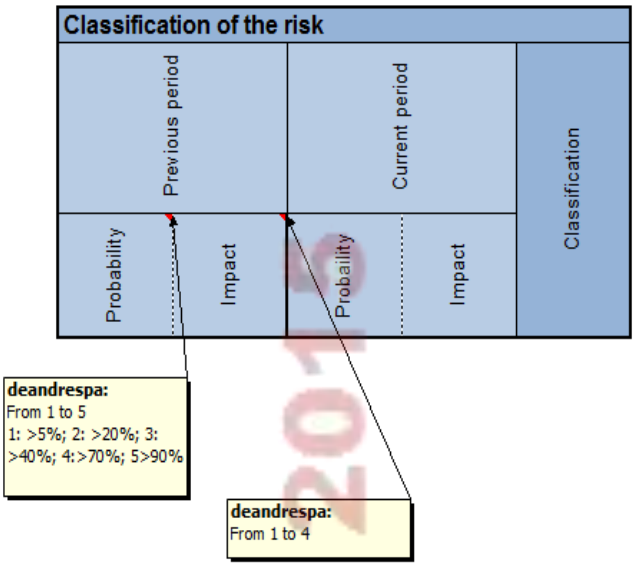


Figure 35 Detail of risk plan – Classification [Original figure]

Finally the third group of columns contains information on how to manage the risks.

It says whether it is worth to take any action and the classification we pretend to get for the risks by means of that action. It also keeps track of the expiration date and the status of a given risk.

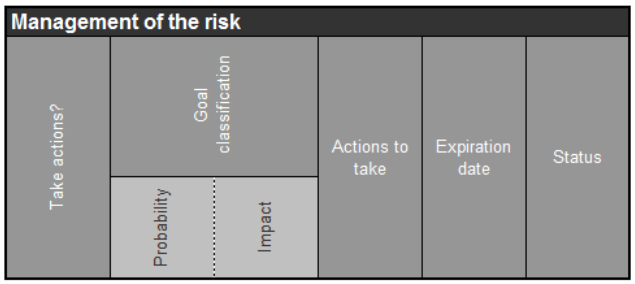


Figure 36 Detail of risk plan – Management [Original figure]

4.7.4. Create a communications plan

The main communication instances have already been considered in the quality assurance plan so for this point we only need to make sure that all stakeholders are informed of the multiple meetings that will be held.

It is still needed, anyway, to define how the different departments will interact with each other. Will all the communications be held through a specific web application like, for example SharePoint or will it be accepted to exchange demands via email? How will files be exchanged? How will the Project Sponsor inform the team about a change? Will the Project Manager be the only person allowed to answer these demands? Which mean will be considered the official one for doing so?

The communications plan is an important entity because of the implications that it might have, but it is so heavily dependent on the culture of the organization that we will not study it in detail in this master thesis.

4.7.5. Contract suppliers

Although MPMM includes this activity among the activities to be performed for a medium sized project, this is an activity of a much bigger scope than a project. Contract suppliers are usually contracted at company level and not in the context of a particular project due to the fact that better conditions can be achieved applying economies of scale.

Given the previous reasons we are not further considering this issue here.

4.7.6. Create an acceptance plan

On the contrary, we consider an acceptance plan crucial for our project, so we can determine that our project has been completed successfully or if not to which extent the project has achieved its goals.

The acceptance plan is closely related to the quality plan but it includes time and contractual documents considerations.

Which documents should the client sign to certify that our project is finished? One document at the end of the project? Or one document after the successful testing of each environment?

How long can the customer take to accept or reject our project, fifteen days?, fifteen years? It is obviously not the same and it should be clearly stated at the planning phase to avoid scope creep.

4.7.7. Perform a phase review

Like in the case of the initiation phase at the end of the planning phase the Project Manager has to assess if the goals of the phase have been completed, to formally inform the Project Sponsor (and the rest of stakeholders) of the overall status by means of the “Planning phase review form”.

If changes or new issues have arisen the Project Manager needs to update the project charter.

The Project Sponsor has to give his authorization to go forward the next phase.

ABC INC.

Planning Phase Review

A. General Information

Project Title:	System for the maintenance of the corporate portable computers	***Project Working Title:***	SYSMA
Project Manager:	Eira Woodham	***Project Sponsor:***	Halvard Adamsen
Project Client:	ABC Inc.	***Prepared By:***	Eira Woodham

B. Overall Status

Include a brief description of how the project is running

Project running as planned.

C. Initiation phase checklist

Topic	Issue	Status	Correct?	Comments
Schedule		Project charter compliant	Yes	
Cost		Project charter compliant	Yes	
Deliverables	Project plan Quality plan Risk plan Communications plan Acceptance plan Project charter	Done & validated Done & validated Done & validated Done & validated Done & validated No update necessary	Yes Yes Yes Yes Yes Yes	Documentation stored in //Projects/ongoing projects/SYSMA
Risks		No risks detected	Yes	
Changes		No changes	Yes	
Issues		No issues	Yes	

D. Detail of the deviations in schedule or cost.

More information if available

N/A

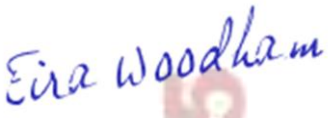
E. Detail of the changes, risks and issues detected

More information if available

N/A

ABC INC.

F. Approval section

	
Halvard Adamsen Project Sponsor	Eira Woodham Project Manager

4.8. Game Part I (or what the Scrum team is doing meanwhile)

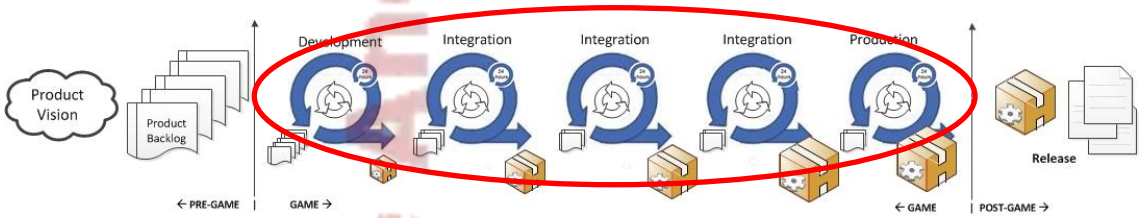


Figure 37 Scrum Game I [Original design]

In this phase, after a short pre-game phase we go into the actual development of the application.

As previously seen in 2.5.2 the development is organized in iterations called Sprints in Scrum. In the ideal world a functional product is ready to be tested at the end of each iteration so that the Product Owner can provide early feedback to the team. In the other hand, the team has the opportunity to propose new ideas to maximize the value of the final product. Unfortunately in the real world most new created Scrum teams find it hard to achieve the goal of having a functional product at the end of each iteration and it takes some training to do it.

Scrum describes four communication instances or events that will be explained in their chronological order in the Project:

- Sprint planning
- Daily scrum
- Sprint review
- Sprint retrospective

We call Sprint to the time-box containing all these four communication instances plus the actual development work.

In Figure 38 we can see a graphical representation of this, where the communication instances have been written in green characters:

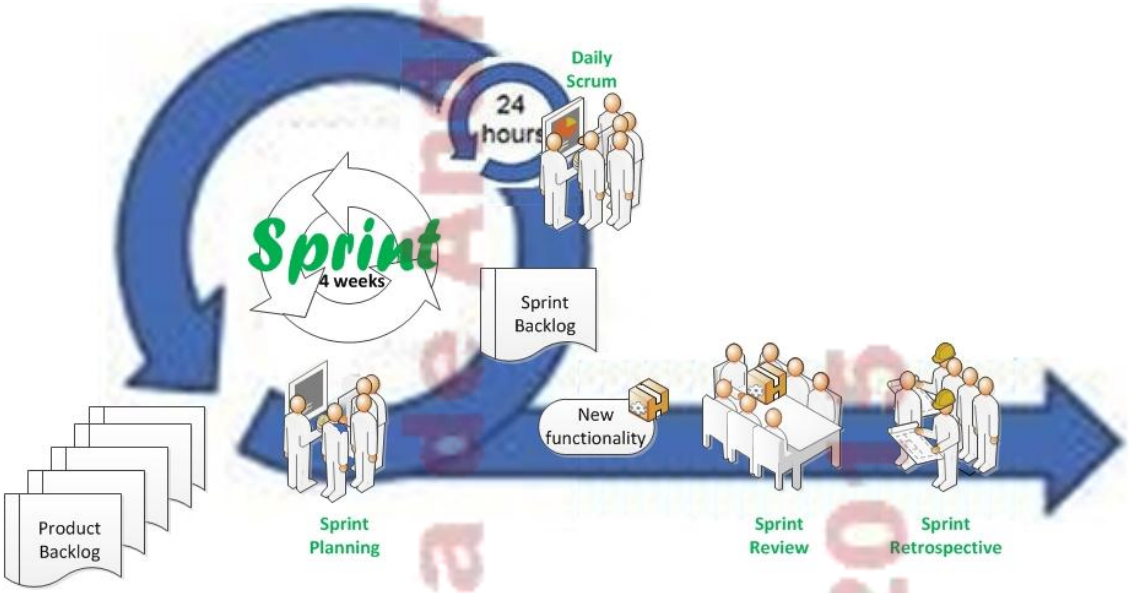


Figure 38 Scrum Sprint [Original design]

The **Sprint Planning** is a meeting whose maximum duration is eight hours for a four weeks sprint. It is probably the most important meeting in Scrum. The objective of this meeting is to answer the what and the how [32], that is:

- What can be delivered in the increment resulting from the upcoming sprint?
- How will the work needed to deliver the increment be achieved?

A subset of the Product Backlog will be chosen to be developed in the sprint taking into account the capacity of producing that the team has. An objective of the sprint has to be defined and no changes that could endanger this objective are allowed during the sprint. The quality objectives cannot be changed either in the duration of the sprint. The only parameter that can be renegotiated and clarified between the Product Owner and the Team during the sprint is the scope, as more about the product is learned.

The team decides how the work has to be done to best achieve the sprint goal and builds the Sprint Backlog, which is the chosen subset of the Product Backlog together with the way to do the work.

The Product Owner is the only person authorised to assign priorities to the tasks. In the other hand the team members are the only people that can estimate the effort needed to accomplish the tasks. As the team members estimate that effort, there is a high probability for doubts about the scope to arise so it is very important that the Product Owner attends the meeting.

The team can invite experts to this meeting in order to receive advice on how to best do the work but the guests cannot establish priorities nor change the estimations.

One item from the Product Backlog will typically be splitted in a set of sub-activities that are small enough to be assigned to a person but also big enough to make sense by itself. It is easier to tell the effort needed to complete a task if it is a small task and also it is more motivating for a team member to work in a task that has sense by itself.

An example of organization of the Sprint Planning meeting can be seen next [40]:

- The Product Owner presents the goal of the sprint and resumes the Product Backlog. A date and place for the demonstration of the Product that will take place at the end of the sprint is agreed.
- The team decomposes the Product Backlog items if necessary and makes estimations of the effort for each item.
- The Product Owner updates the priorities of each item. If there are any doubts about any of the items they are clarified. The way to test each element is written for every high priority item. Note that this is the equivalent to the acceptance criteria of the predictive part.
- The team selects the items that will be completed in the current sprint and speed calculations are made to check if it is feasible to accomplish those items in the sprint
- The place and time for the daily scrum is agreed.

This is the Sprint Backlog agreed for the first sprint of the SYSMA project:

ID	Name	Priority	Initial effort estimate	HowTo for testing	Comments
1	Automatic updates	10	12	Configure an update over a group of computers in the parameters sheet. Check that the update has been done as planned	
3	Monitor status at least every three days (with exportable reports)	8	6	Check that a report is exported every three days from the start date of the system	It can easily be made configurable.

These items are too big to be assigned to one person so they are decomposed into several sub-items.

ID	Name	Prio	Initial effort estimate	Subitems	HowTo for testing	Comments
1	Automatic updates	10	5	Build communications module	Configure an update over a group of computers in the parameters sheet. Check that the update has been done as planned	
			2	Build software repository		
			3	Build scripts for scheduling		
			1	Etc.		
			1	Etc.		
3	Monitor status at least every three days (with exportable reports)	8	6		Check that a report is exported every three days from the start date of the system	It can easily be made configurable.

The **Daily Scrum** is a short meeting (about 15 minutes) that takes place every morning. At this meeting the team reviews the work done the day before and plans the upcoming day. Every member tells what he has done the day before, what he plans to do in the present day and which problems or difficulties he has found. It is a way to maintain the team synchronized and to detect problems at an early stage. This communication makes it possible also that the team works as a real team and not as individuals, by working in group in a brainstorming manner to find solutions for the difficulties encountered by each team member. This way the probability that the project will be stopped is minimized.

The Scrum Master makes sure that the meeting is held every day, that only the members of the team take part in the meeting, and that it lasts no more than 15 minutes but the team is the responsible to manage the meeting.

Whether the Product Backlog belongs to the Product Owner the Sprint Backlog belongs solely to the team. The team can add items to the Sprint Backlog as they realize that some task has to be done to achieve the sprint goal.

The **Sprint Review** is an up to 4 hours meeting for 4 months sprints and the attendants are the Scrum Team, the Scrum Master, the Product Owner and any key stakeholders invited by the Product Owner.

The Product at the current moment is presented. The team explains what has been done and what has not been done, which difficulties have been found and how they managed them and also ideas to improve the product are discussed. The Product Owner and the stakeholders or any of the attendees can participate and propose new ideas. If the Product Owner considers that the new functionalities or the changes proposed deserve it he can add

new items to the Product Backlog. This is the time for the Product Owner to list all the remaining work.

The Product Backlog is a living entity and evolves as the Product (or the environment of the Product in very innovative environments evolve)

The **Sprint Retrospective** is a meeting limited to 3 hours for 4 months sprints where the Scrum Team analyses itself and the last sprint with the aim of improving the way the team works. The team realizes what went and what did not go so well or not as well as expected to find out the causes of both situations, so that the team can repeat the good things in the future and try to avoid what did not work. It is about becoming consciously aware of this and be more effective and efficient with each iteration.

Whether the Sprint Review is about the Product the Sprint Retrospective is about the people, the Scrum Team.

In the SYSMA Project the Scrum Team starts doing Sprints that will last until the end of the Execution Phase of the Infrastructure part. Both parts need to be synchronized, but we will talk about this at the end of the Execution phase of the infrastructure part, in 4.10, not to anticipate events now.

4.9. Project Execution (MPMM)

According to MPMM the following tasks must be accomplished in this phase in the case of a medium-sized project:

- Build deliverables
- Monitor and control
  - Time management
  - Cost Management
  - Quality management
  - Change management
  - Risk management
  - Communications management
- Phase review

From the additional tasks that should be performed in the case of a large project we consider adequate also this one:

- Acceptance management

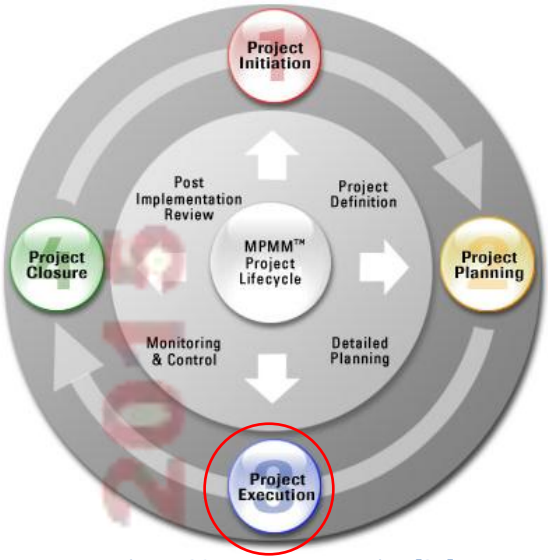


Figure 39 MPMM Execution [21]

If we have completed the planning phase thoroughly there will be very little to think of in this phase. The project team will be designing and constructing the products under the surveillance of the Project Manager.

4.9.1. Build deliverables

“Building deliverables” is a huge task that summarizes all the activities performed by th team in order to produce the deliverables. Let’s have a closer look to the Work Breakdown Structure described in 4.7.1:

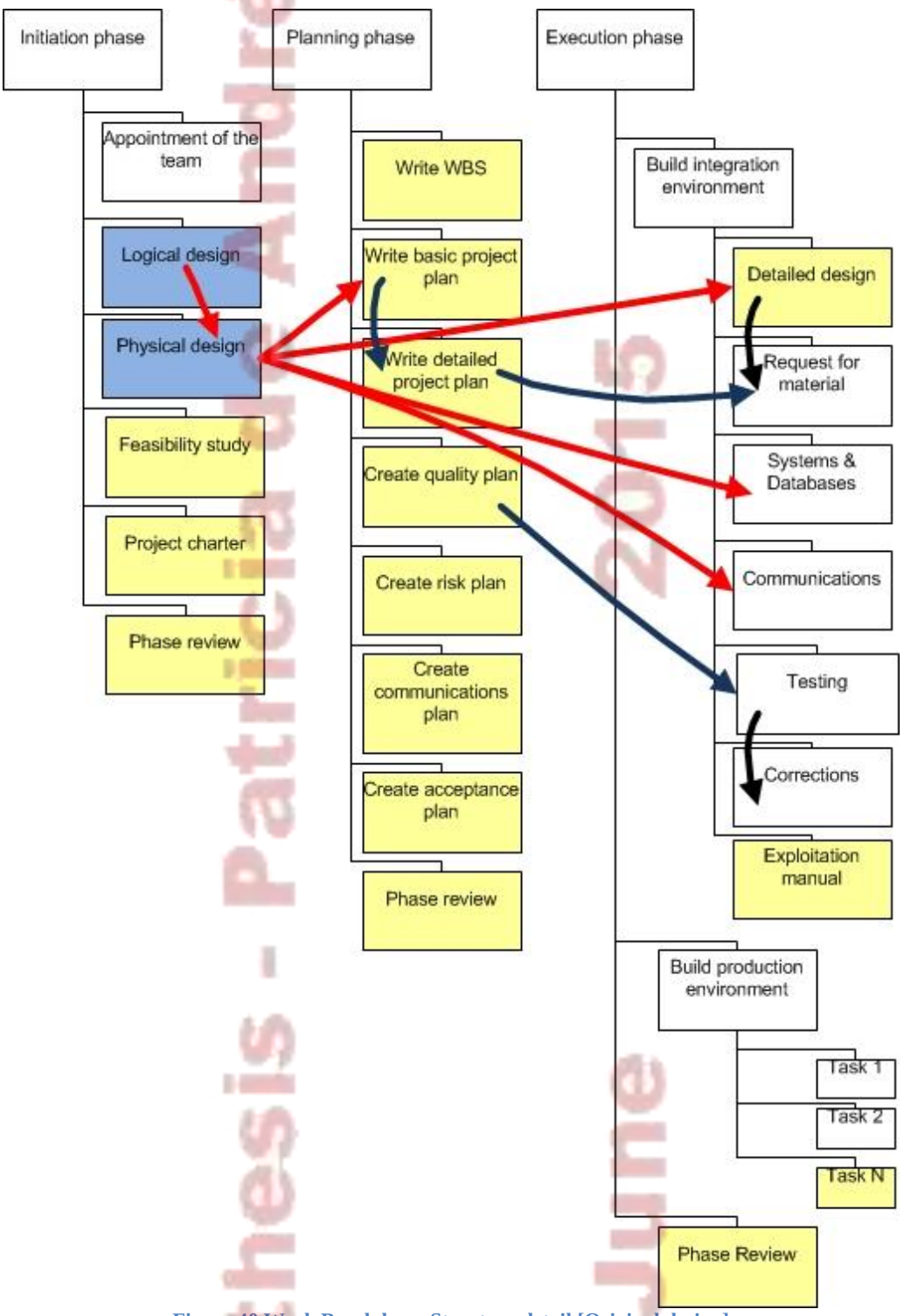


Figure 40 Work Breakdown Structure detail [Original design]

In Figure 40 some relations among activities have been depicted.

Everything susceptible to be predicted has been described in the different documents created so far such as:

- The physical design
- The detailed project plan
- The quality plan (including the testing plans)
- The acceptance plan

And the effort has been done to keep under control unpredictable circumstances by means of the risk plan.

Now it is the time to produce the deliverables according to these documents.

In the ideal case we will only need to follow the detailed plan we have produced during the planning phase, in the real case there will be circumstances to manage, adjustments and corrections to do, there might be delays in the arrival of the material and even staff that leaves the project (these circumstances are, or should be considered in the risk plan thus making feasible a quick reaction).

The deliverables for the infrastructure part, which were recorded as well in the project charter (see 4.5.3), are the following:

- Integration infrastructure
- Production infrastructure
- Detailed description of both environments
- Exploitation manual for both environments

The detailed description of both environments corresponds actually to the physical design of the environment, and it has been done during the planning phase, with as much detail as available, and it will be completed during the execution phase with all the information that we can only have when building the environment, such as IP assignment, name and physical location of the machines in the CPD as well as any relevant technical information.

In the exploitation manual we will include any relevant information for the production support, such as the meaning of the alerts of the machines, if there is a need to reset the infrastructure with a given periodicity, what to do in a set o given cases, etc. This will be completed during the building and testing of the infrastructure.

Tests must be performed for anything that is installed, and also global tests will be done at the end. These tests are described in the quality plan. The new infrastructure will be tested, as well as the interactions (if any) with other systems in the company.

A well-defined acceptance plan will tell us the essential tests that must be passed in order to consider our infrastructure deployed and avoid scope creep.

At the end of the execution phase we will end up with the agreed deliverables at the required date and cost. The more exhaustive the planning phase the more solid the execution phase and the less surprises we will have.

4.9.2. Monitor and control

If in the previous paragraphs we have been talking about the activities done by the project team during the execution phase, this is the time to look what the project manager is doing meanwhile.

After the planning phase it could be thought that the project manager can now relax and wait until the deliverables are produces according to the plans; this is not at all the case. The project manager faces a huge coordinating work at this phase that is crucial for the successful end of the project.

The project manager is there to facilitate as much as possible the work of the team and to take care that the project is undertaken according to the parameters of cost, time and quality defined.

As in the previous case of building the deliverables, the activities that the project manager performs now have also been accurately described in the planning phase. More precisely the project manager will manage quality and risk as defined in the plans created in that phase (see 4.7.2 and 4.7.3) and make sure that the needed communication is done in the different instances detailed in the Communications Plan (see 4.7.4) .

The project manager will warranty that everything flows as predicted, measuring the actual performace and comparing it constantly with the expected performance to include corrective actions if necessary.

Any changes to the initial plan have to be studied to evaluate the impact on the project and alert the Project Sponsor and the high management of the circumstances that might endanger the achievement of the project goals. The way to demand changes and respond to them can be considered inside the Communications plan or in the cases that there is a big probability of changes to arise define an specific procedure to face them.

Special consideration deserve time, cost and acceptance management, which we will see in the following paragraphs.

4.9.2.1. Time management

Every project team member will be asked to record the time spent in each of the activities that he executes, and the time he estimates is needed to complete the activity.

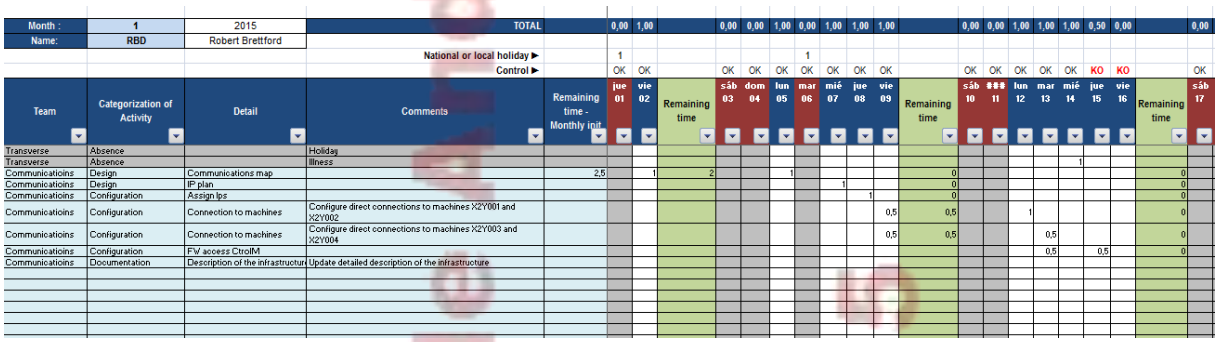
The reason for recording the time spent in activities is to provide the Project Manager with very valuable and daily updated information that he will use to check if the project is running as expected and quickly take an action plan to resolve any slippage, inform the Project Sponsor, etc.

He will be able to detect surcharges early enough to prevent team members burn out and to ask for or relocate resources if needed. If an activity is lasting much more than expected he can find out about hidden difficulties and asking more experienced individuals in the organization for help, etc. The Project Manager will also improve his/her knowledge on estimations by checking the real time spent on the tasks.

It is very interesting that the records are built in an exploitable format, with categorization of the activities. This way the records of the whole team can be treated automatically so that the Project Manager can quickly assess:

- whether the project is on time or not
- percentage of completion of the activities of a certain category
- perception of the team members of the time needed to complete the activities
- which type of activities are being more time consuming

Here we can see an example of time control sheet (the whole view and two detail views):



Month :	1	2015	TOTAL																															
Name:	RBD	Robert Brettford																																
National or local holiday ►					1									1																				
Control ►					OK	OK		OK	OK	OK	OK	OK	OK	OK		OK	OK	OK	OK	OK	KO	KO		OK										
Team	Categorization of Activity	Detail	Comments	Remaining time - Monthly init	jue 01	vie 02	Remaining time	sáb 03	dom 04	lun 05	mar 06	mié 07	jue 08	vie 09	Remaining time	sáb 10	### 11	lun 12	mar 13	mié 14	jue 15	vie 16	Remaining time	sáb 17												
Transverse	Absence		Holiday																															
Transverse	Absence		Illness																		1													
Communicatioins	Design	Communications map		2,5		1	2			1					0								0											
Communicatioins	Design	IP plan										1			0								0											
Communicatioins	Configuration	Assign Ips											1		0								0											
Communicatioins	Configuration	Connection to machines	Configure direct connections to machines X2Y001 and X2Y002											0,5	0,5			1					0											
Communicatioins	Configuration	Connection to machines	Configure direct connections to machines X2Y003 and X2Y004											0,5	0,5				0,5				0											
Communicatioins	Configuration	FV access CtrolM													0				0,5		0,5		0											
Communicatioins	Documentation	Description of the infrastructur	Update detailed description of the infrastructure																															

Month :	1	2015	TOTAL
Name:	RBD	Robert Brettford	
			National or local holiday ►
			Control ►

Department	Team	Categorization of Activity	Task CODE	Detail	Comments
Transverse	Transverse	Absence			Holiday
Transverse	Transverse	Absence			Illness
Communications	Communicatioins	Design			
Communications	Communicatioins	Design			
Communications	Communicatioins	Configuration			
Communications	Communicatioins	Configuration			Configure direct connections to machines X2Y001 and X2Y002
Communications	Communicatioins	Configuration			Configure direct connections to machines X2Y003 and X2Y004
Communications	Communicatioins	Configuration			

0,00	1,00		0,00	0,00	1,00	0,00	1,00	1,00	1,00		0,00	0,00	1,00	1,00	1,00	0,50	0,00		0,00
1						1													
OK	OK		OK	OK	OK	OK	OK	OK	OK		OK	OK	OK	OK	OK	KO	KO		OK
jue 01	vie 02	Remaining time	sáb 03	dom 04	lun 05	mar 06	mié 07	jue 08	vie 09	Remaining time	sáb 10	dom 11	lun 12	mar 13	mié 14	jue 15	vie 16	Remaining time	sáb 17
															1				
	1	2			1					0								0	
							1			0								0	
								1		0								0	
									0,5	0,5			1					0	
									0,5	0,5				0,5				0	
														0,5		0,5		0	

Figure 41 Time control sheet [Original design]

4.9.2.2. Cost management

Any cost incurred by the project has to be documented in a formal expense document that will be validated by the Project Sponsor.

Some costs are very easy to record (materials, technical intervention of suppliers…)

Others are not so easy like, for example the exact cost of the human resources, but they can still be calculated by means of the time control sheets. By means of the time control sheets we can even asses the total cost incurred by a particular type of activity until a given moment.

Other costs are much more difficult to measure like, for example, the percentage of the electricity and heating consumed in the offices because of the employees working in this particular project, or the cost of the people in the organization who has participated in the project but we do not know how much time they have invested. For example, how much time does the Project Sponsor need to make a decision on whether to approve or not an expense sheet?

If we desire or need to consider absolutely all of the costs we can estimate that the costs that cannot be easily measured represent a given percentage of the total cost of the project and take that way all the costs into account.

Costs need to be measured periodically to determine if we have or we expect to overrun the budget of our project.

4.9.2.3. Acceptance management

As we saw in section 4.7.6 (Create an acceptance plan) there is different ways (or moments) to gain the acceptance of the customer. At this point we will just follow the acceptance plan previously created and validated by the customer. For each deliverable we will check if the agreed tests or conditions are met.

Nevertheless it is better to gain the acceptance of the customer after each deliverable because of the following reasons:

- Identify customer acceptance issues early in the project.
- Better meet the expectations of the customer by adapting deliverables if necessary
- Maximize customer confidence in the delivery of the project
- Prevent scope creep: once a deliverable has been accepted further changes will not be taken into account.

4.9.3. Perform a phase review

As in the previous phases at the end of the execution phase the Project Manager has to assess that the goals of the phase have been completed, to formally inform the Project Sponsor (and the rest of stakeholders) of the overall status by means of the “Execution phase review form”.

If changes or new issues have arisen the Project Manager needs to update the project charter.

The Project Sponsor has to give his/her authorization to go forward the next phase.

A simple template like those used in prior phases has to be fulfilled as evidence that the review has been done, as a tool not to forget any detail that has to be reviewed and to formerly document the approval of the Project Sponsor to go forward to the next phase.

The template for the SYSMA project of ABC Inc. is shown in the next pages.

Execution Phase Review

A. General Information

Project Title:	System for the maintenance of the corporate portable computers	***Project Working Title:***	SYSMA
Project Manager:	Eira Woodham	***Project Sponsor:***	Halvard Adamsen
Project Client:	ABC Inc.	***Prepared By:***	Eira Woodham

B. Overall Status

Project running as planned.

C. Initiation phase checklist

Topic	Issue	Status	Correct?	Comments
Schedule		Project charter compliant	Yes	
Cost		Within budget	Yes	
Deliverables	Integration infrastructure	Completed & accepted	Yes	Documentation stored in //Projects/ongoing projects/SYSMA
	Production infrastructure	Completed & accepted	Yes	
	Detailed description of integration infrastructure	Completed & accepted	Yes	
	Detailed description of production infrastructure	Completed & accepted	Yes	
	Exploitation manual for integration infrastructure	Completed & accepted	Yes	

ABC INC.

	Exploitation manual for production infrastructure Project charter	No update necessary	Yes	
Risks		No risks detected	Yes	
Changes		No changes	Yes	
Issues		No issues	Yes	

D. Detail of the deviations in schedule or cost.

More information if available

N/A

E. Detail of the changes, risks and issues detected

More information if available

N/A

F. Approval section

Date __/__/__

Halvard Adamsen
Project Sponsor

Eira Woodham
Project Manager

4.10. Game Part II (Scrum)

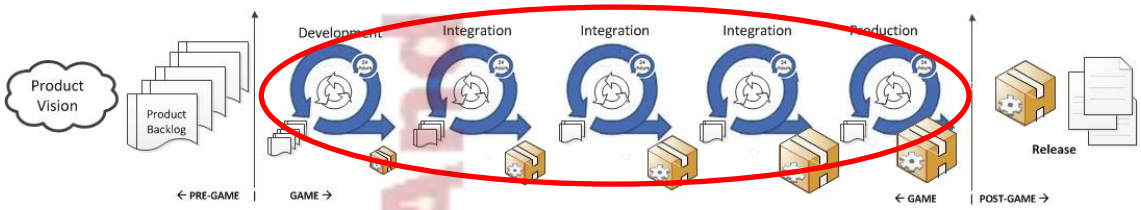


Figure 42 Scrum Game II [Original design]

In the following paragraphs we will continue talking about the Game phase that started in 4.8.

The game phase of the application part starts before the execution phase (let's review Figure 47) of the infrastructure part. This means that the first sprint has to be done using a simulated local environment that we will call the "Development environment" (simulating the required elements that are still not physically present).

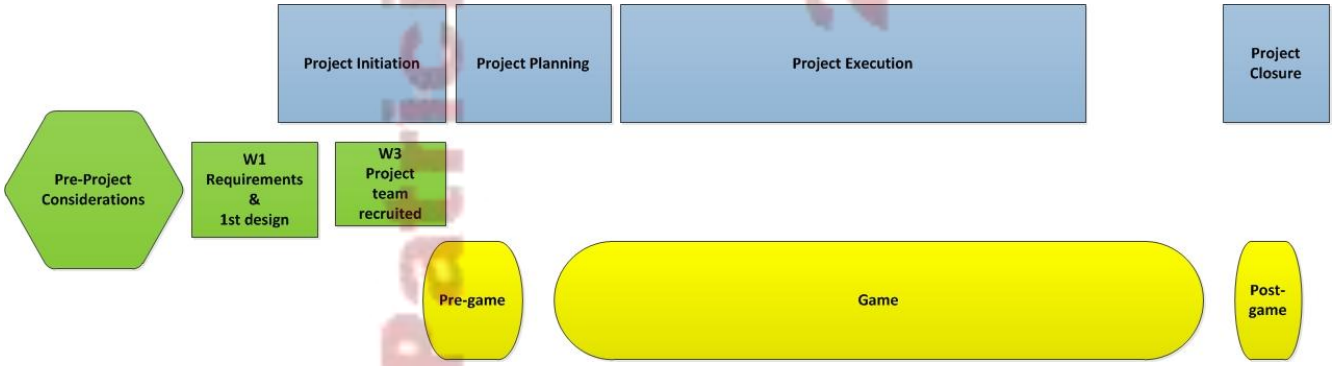


Figure 43 Predictive and adaptive phases [Original design]

In effect, if we take a closer look to the part of the diagram (Figure 44) that corresponds to the execution part of the application we can see at the top the different environments in which the work will be undertaken. These environments have been written in green in Figure 44, that shows the detail of the Game phase.

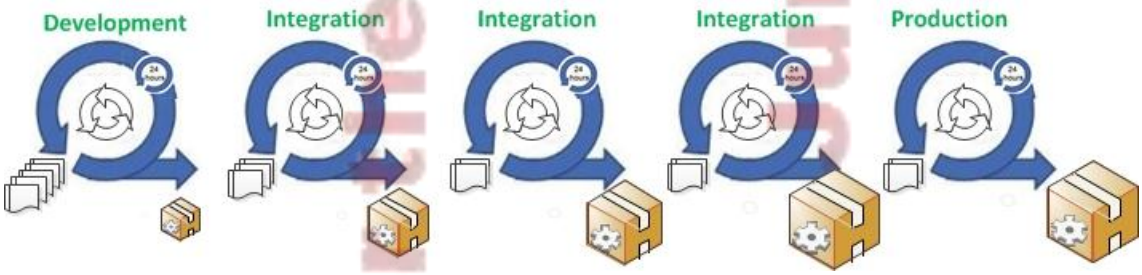


Figure 44 Detail of the Game phase [Original design]

Note that the product increases with each iteration. The philosophy is having a product that we can test, that is a functional product or prototype, at the end of each iteration. This allows discussions to be done over a real thing, minimizing the risk of misunderstanding and

maximizing the opportunities of innovating and the value of the final product. Each product is the sum of the previous product plus the product increment developed at the current iteration.

Note that the product is the same at the end of the penultimate and last iteration. This is conceptually so: exactly the same product it must be deployed in both environments, the only differences will be the parameters that have to be configured to adapt the product to one or the other environment. The product that will be deployed in the Production environment has to be free of bugs and have no impact in any other projects already running in the Production environment.

The last opportunity to introduce changes is at the Sprint Review of the third iteration (see 4.8 for further detail on the Sprint Review) because at the end of the fourth iteration the final product has to be deployed and running free of bugs in the Integration environment so that the fifth iteration can be dedicated to deploy and adapt the product in the Production environment, and also to assure that everything works as expected, prepare the transfer of the project to the maintenance team, etc.

The Product Backlog list is supposed to decrease until it contains no tasks (because they have completed to get the final product). Nevertheless this is not always so because, at it has been said before, the Product Backlog is a living entity where the Product Owner can add new items that have arisen from the empirical use of the prototype, add things that might have been forgotten or simply add value to the final product through completely new functionalities. The cost and impact of this has to be analysed to decide if the current release will include the proposed changes or these will have to wait for another release of the product. Sometimes a Scrum team can face an over-demanding Project Sponsor and if the team suspects that there is no physical time to implement all the requested changes in the sprint a good way to contain change in this kind of situations is to proceed as described by the Kanban methodology (see 2.5.3.1), thus controlling the work in progress at a given moment.

A way to control the work in progress is to manage the Sprint Backlog through a board of post-its or cards, each one with its estimate effort and negotiate with the Product Owner that the introduction of new functionalities implies the suppression of functionalities of the same global estimated effort.

4.11. Post-game (or how the Scrum team finishes its part)

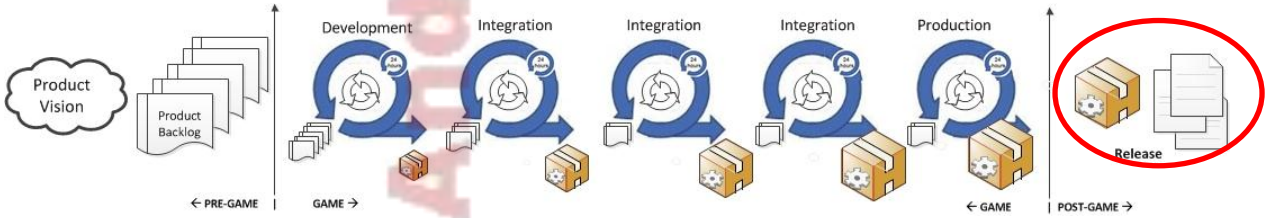


Figure 45 Scrum Post-game [Original design]

This phase is meant to be very short compared to the Game phase. The final product is finished with no surprises for the Product Owner that has been participating all the time or at least has tested and given feedback to three prototypes (at the ends of iterations one, two and three), and has seen the final product working in the integration and production environments.

The product has been improved thanks to the ideas of the Scrum team and it makes the most of the infrastructure that has been deployed. On the other side the team is more motivated than ever, feels proud of its work and is willing to show the maintenance team how to take care of the new application.

This phase is intended to complete the documentation on the work that has been done and transfer the application to the maintenance team. The Scrum team will be still be available during some time to assure that everything is right and working as expected in Production and to resolve any bug that might arise, even if the risk that this might happen has been minimized by developing over working prototypes.

4.12. Project Closure (MPMM)

According to MPMM the following tasks must be performed in this phase:

- Confirm project closure
- Document with project closure report
- Complete project closure actions
- Review project completion

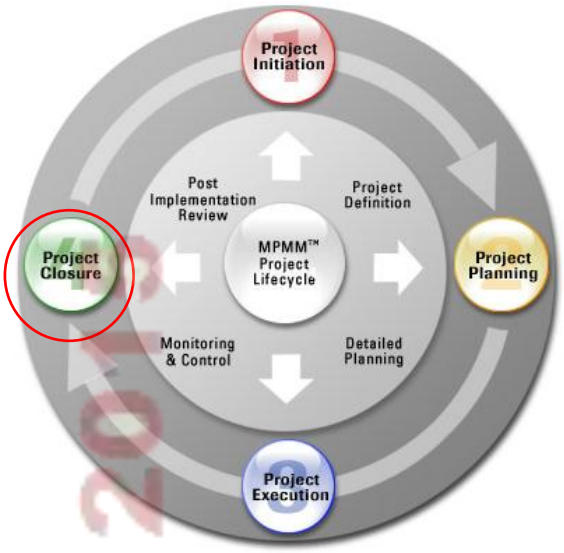


Figure 46 MPMM Closure [21]

4.12.1. Confirm project closure

At this stage the Project Manager has to look back again towards the Project Charter to make sure that the project requirements have been fully met by the project. As the project charter also contained some basic lines about the application part, these will be reviewed as well.

Have all the project objectives stated in the Project Charter been met?
Have all the deliverables listed in the Project Charter been met?
Has the project provided the stated benefits?

Even though all the answers to the previous questions are affirmative there could be remaining issues (typically tasks that where previewed in the project plan) that are incomplete and that should be taken into account to deal with them when it is possible.

The Project Manager identifies the project completion criteria. If the project is finished we can go on towards the documentation of the closure of the project, if not we have first to resolve the remaining issues.

4.12.2. Document with project closure report

Once the Project Manager has confirmed that the project has been completed he will document all completion criteria. He will also give a measure of the quality of the process management processes that have been followed during the project life. He will review the quality plan that he prepared in the Planning phase and evaluate to which extent the criteria have been globally fulfilled.

The Project Manager will describe as well how the project closure actions will be completed. Although these tasks should have been taken into account in the whole project plan he/she can give here a more detailed description of the actions which are:

- How will be the infrastructure forwarded to the Production Team? Will the Project Team provide any training to the Production Team? Is any shadowing of both teams previewed?
- How will the documentation of the project provided to the customer? In a CD-ROM? Will it be stored in a given database? In paper?
- Will the best practices database of the organization be feed from the experience acquired by means of this project?
- Will there be a warranty period? Need any resources to remain available for the project? To which extent?
- How will the customer be informed of the completion of the project? And the project team?

Actually the vast majority of these tasks have been already taken into account before in the planning and the costs estimates of the project, and other documents such as the communications plan. At this point, if we have done well before, it is only about taking all those issues over a paper.

The resulting document has to be validated by the Project Sponsor before proceeding to complete the project closure actions.

4.12.3. Complete project closure actions

At this stage the Project Team has to complete the closure actions identified in the project closure report.

4.12.4. Review project completion

This activity is actually outside of the project (because the project has already been finished and closed). MPMM suggests that a third neutral person, i.e. somebody from the organization that can offer an unbiased opinion should asses the success (or not) of the project.

This is a so called a Post-Implementation Review, and it consists in checking if the project has met the stated objectives. Did the outcome of the project bring the expected benefits to the organization?

To asses this the following issues can be checked:

- Project performance
- Project conformance
- Project achievements
- Project failures
- Lessons learned

In our case of study it is interesting to do this review for the project as a whole, that is for the service offered by the infrastructure deployed together with the application developed.

4.13. Project Synchronization (or how all the pieces fit together)

We have partially considered the synchronization among the different parts of the service deployment of the SYSMA project in other sections but let's specifically see how the predictive (or infrastructure) and agile (or application) parts are synchronized.

Figure 47 is a graphical representation of the synchronization of both parts. Like it has been done all along this master thesis blue indicates "predictive" and yellow indicates agile.

On the contrary green shapes (1, 2 and 3) are the parts that are common to the predictive and the agile parts. In effect we do unique pre-project considerations (where we chose the methodology to apply for both parts), a unique preliminary compilation of requirements, and we recruit the project team once.

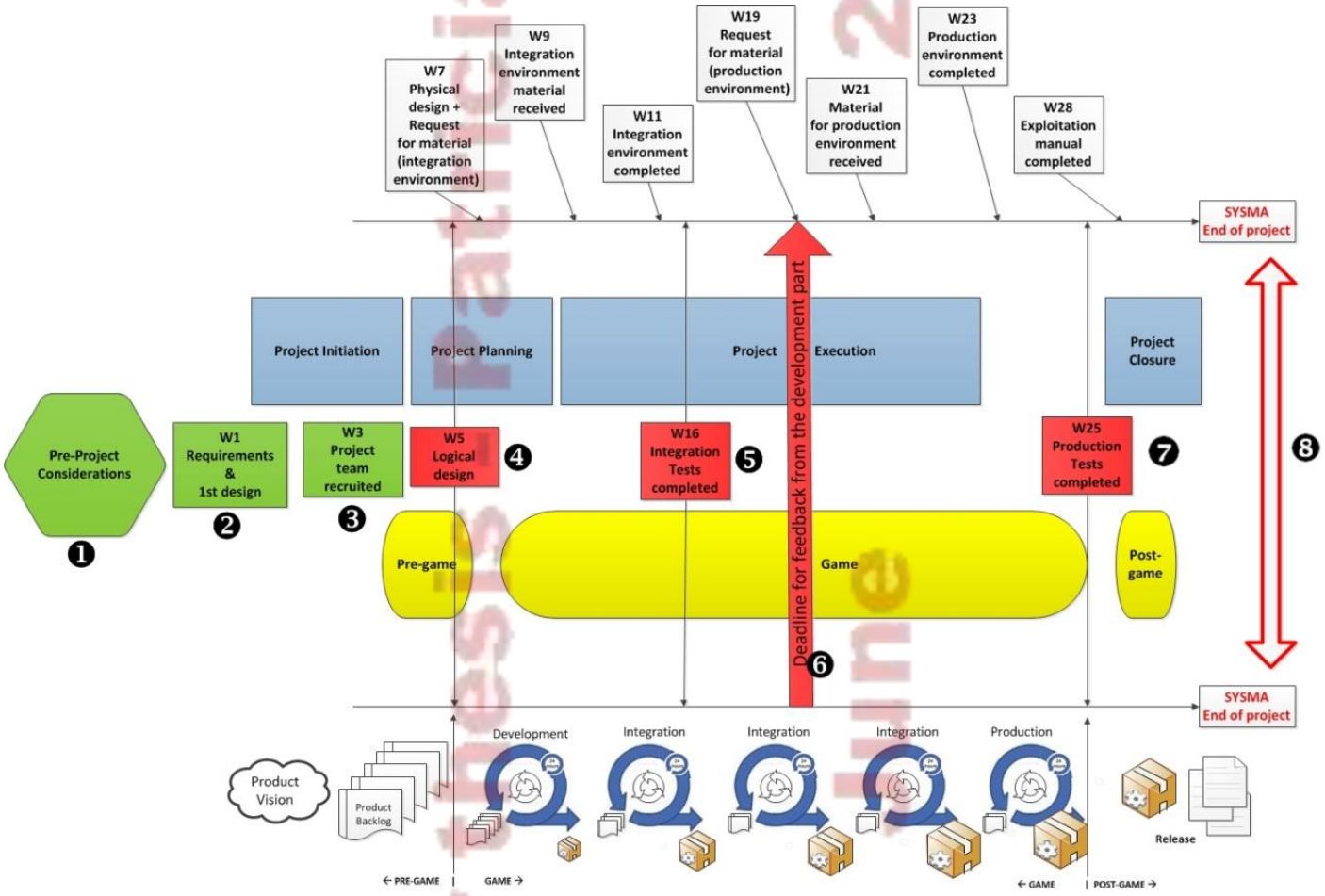


Figure 47 Synchronization of the predictive and the adaptive parts [Original design]

In the upper side of the figure we can see the milestones of the infrastructure part until its completion; right under this the different phases prescribed by MPMM (see 2.5.12.5.1.2).

In the same way, we can see at the bottom of the image the milestones of the application part, and right over it the different phases described by Scrum (see 2.5.1.2).

In the middle of both sides we find the common activities and points of intersection in red.

Everything is designed with the time as a reference. Each “W” refers to the week at the end of which some activity is due. Note how the predictive part is drawn as the phases of the lifecycle of the project and the agile part is represented as a succession of circles. Each of these circles is an iteration and contains a mini project lifecycle of one month.

At the very end, at the red arrow number 8, everything converges to give birth to the complete service that has been created by means of the SYSMA which has been managed using MPMM and Scrum as main methodologies but also practices from Kanban, CCPM and XP when needed.

Chapter V: Conclusions

Conclusions

Innovation has become increasingly important in all sectors and this is particularly true in the technology sector where project managers play an important role.

Big companies of this sector are investing a lot of money in releasing new versions of their existing products instead of creating new ones (see Iphone6 or PlayStation4 for example). Time to market has become critical and rivalry to be the market leader is now wild.

The way projects are managed have reflected this change in the market, there is no time to finish a perfect product but to deliver an improved version of the same product at each release, and so new standards have appeared in opposition to the old ones.

For some decades some project managers have been defending one or another approach. Some others have become aware of their complementarity. New ideas will appear to address the new challenges and again they will compete with the existing ones, and again there will be early adapters, and again there will be resistance to change, and again… as it has ever been since the humans are over the Earth.

When I began writing this master thesis one of my objectives was to study the different Project Management methodologies or standards in order to compare them and get to know which one of them was the most suitable to apply to the projects I have to deal with in my daily life. This aim has been well beyond achieved and along the way I have learnt that there is no “most suitable methodology”. In contrast, in Project Management, like in any other discipline, the more you know and the more you practice, the easier it becomes and it is no sense to vehemently defend a methodology over the others. They are not opposite but complimentary and suited to different needs. Once this is perceived it is natural to get advantage of it by combining methodologies.

At the beginning, I thought that first of all I had to determine the type of Project Management that best fits a project to manage it using only techniques of that type. This is only a partial truth, as it has been shown in this master thesis it is perfectly possible to perform a predictive Project Management and use adaptive techniques like, for example, adding daily scrum meetings.

This master thesis shows an example of how management can be optimized by maximizing the benefits obtained from combining primarily MPMM, and Scrum, as well as some details from others methodologies like CCPM, and Kanban. Any other technique would be welcomed as well if required. The more the project manager knows, the more tools he/she has and the higher the probability of success of the projects he manages.

After a lot of reading here and there I felt quite confused trying to order this puzzle that is the field of Project Management. I found contradictory information from different sources and in some moments felt quite desperate. Also, after having a look at the results of the survey shown in 1.2, I realized that I was not the only one confused and that it might be a good contribution to order all the concepts and make it easier for others to learn them. In this sense, multiple figures have been added relating the methodologies and trying to always make clear to the reader where he/she is and how one methodology or concept relates to everything else. Also from the results of the survey we can see how the abuse of acronyms can lead to misunderstandings (remember the intruder methodology).

I always wanted to write this master thesis with an empirical focus, and it was a big challenge to do it so because of the difficulty to describe the integration of things that happen

simultaneously (in parallel) over a series support (this paper), but I felt that it was a must to show how this integration of methodologies can be made in real life.

It has also been difficult, but at the same time very rewarding, to include so many concepts and different standards and techniques. Three approaches, four bodies of knowledge, fifteen methodologies… Many times I wanted to consecrate more space to some of them but at the same time I had the certitude that it was more valuable to briefly present as many as I could afford so that the reader got the information enough to know whether something would be useful or not for his/her particular case.

Two schemas for methodology selection have been designed so a suggestion of a particular methodology is made through the answering of some questions and in an easy graphical way. The model can be used to update it with any new methodology that the reader gets to know in the future.

Finally, I wish you have enjoyed reading this master thesis and I would be happy if I have made your vision of Project Management a bit clearer or wider. Any feedback is welcome.

Other information

Time and cost estimates of this master thesis

In this section we can see the time (Figures 48 – 51) and cost estimates (Figures 52 and 53) of this master thesis. The schedule was created using an online tool [41] and afterwards the images were edited to make disappear some items from the legend that where not needed.

Unfortunately the tool did not allow hiding some days of the week, and as long as I mostly worked at weekends in this master thesis the tasks appear broken in many time slots.

Planning groups of tasks have been depicted in blue while executing groups of tasks have been depicted in orange.

The colours of the different tasks are explained in the legend present on the images.

The long blue task referred as “automatic task” in the legend represents the time that the survey about Project Management methodologies (see 1.2) remained open and online to catch answers.

Some symbols have been included representing meetings and approvals, milestones can be also depicted if necessary.

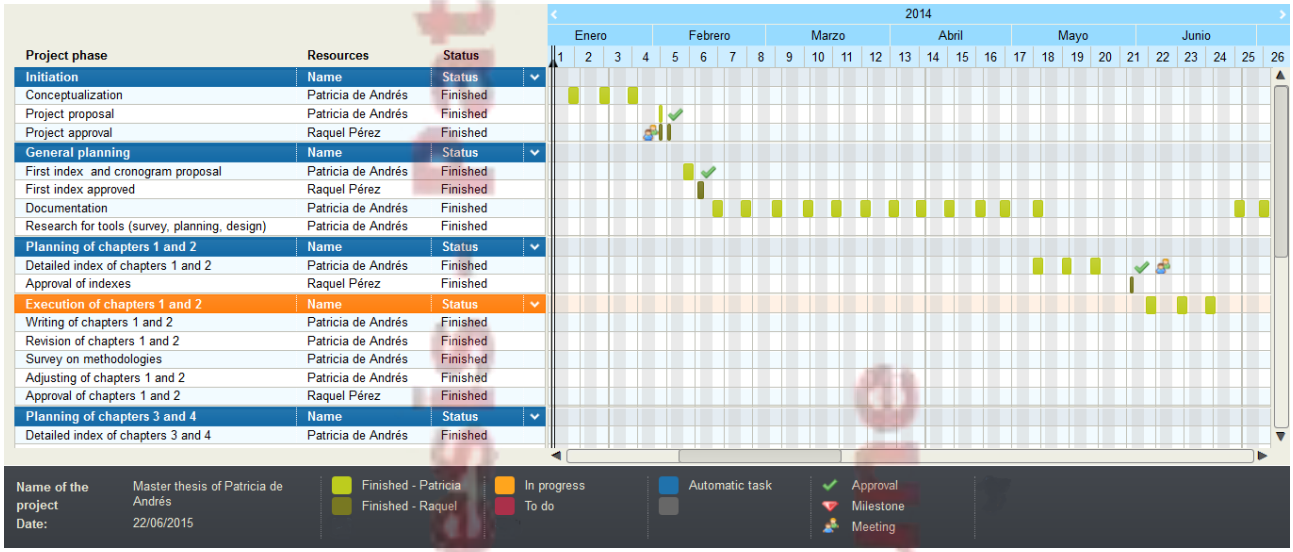


Figure 48 Time estimate of the master thesis I

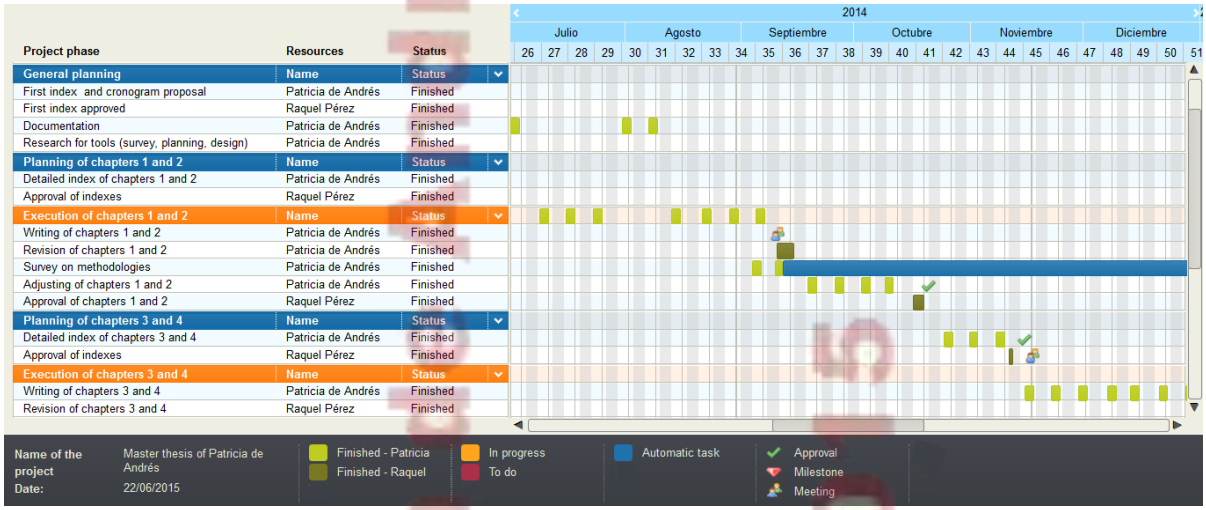


Figure 49 Time estimate of the master thesis II

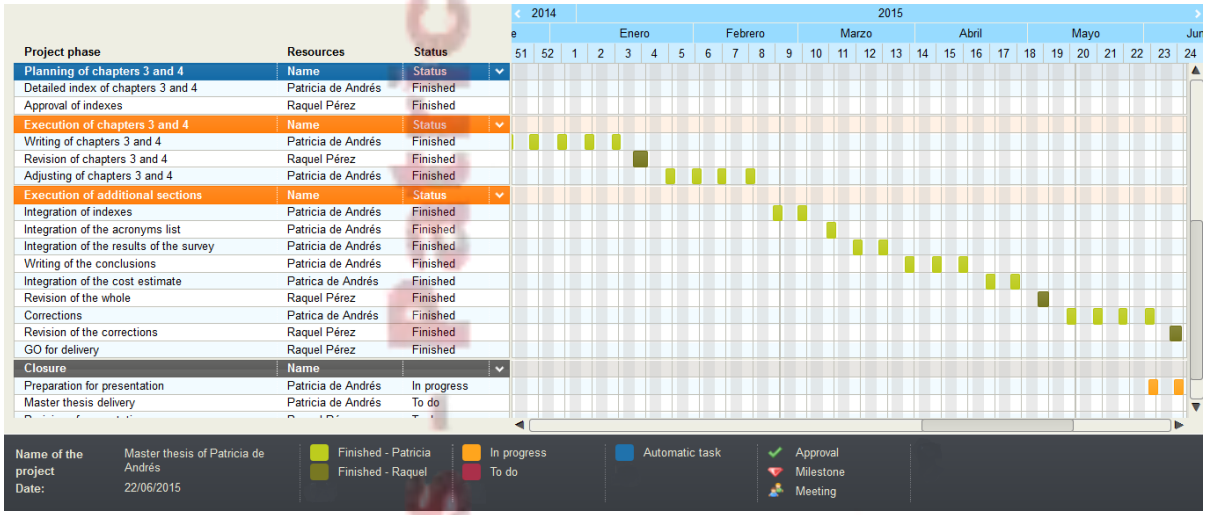


Figure 50 Time estimate of the master thesis III

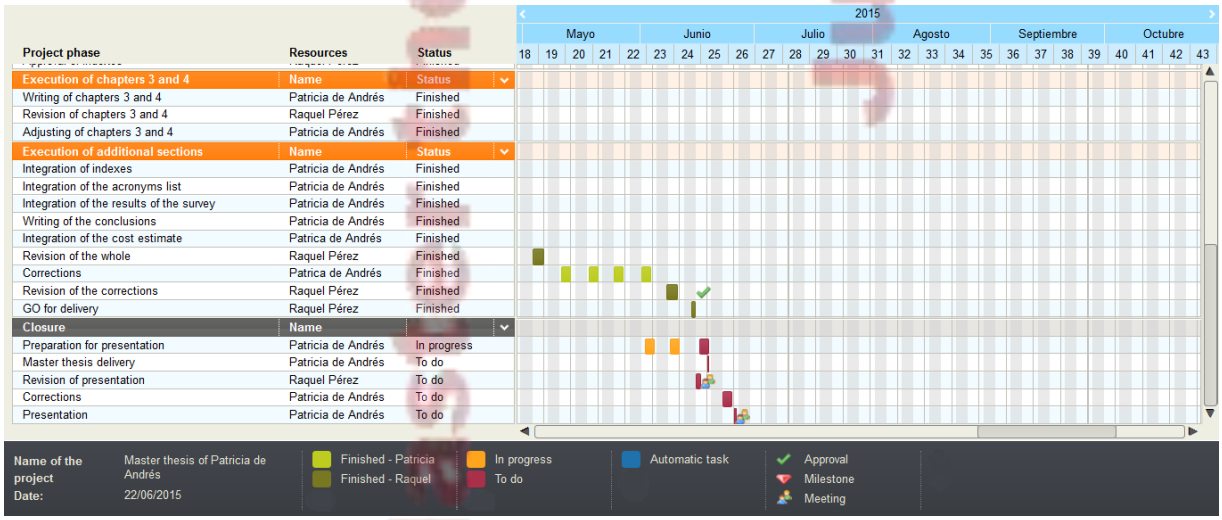


Figure 51 Time estimate of the master thesis IV

UNIVERSIDAD CARLOS III DE MADRID
Escuela Politécnica Superior

COST ESTIMATE OF THE PROJECT

1.- Author: Patricia de Andrés San Felipe

2.- Departament: Signal Theory and Communications

3.- Description of the Project:

- Title: Telecommunication service deployment: Project Management optimization by using different methodologies
- Length (months): **18**
- Indirect costs estimate: **20%**

4.- Total budget of the Project (in Euros):

23.000 Euros

5.- Budget breakdown (direct costs)

STAFF					
Name and surname	**Category**	**Days per month of dedication**	**Dedication (hombres mes) [a)]**	**Cost person month**	**Cost (Euro)**
Patricia de Andrés	Ingeniero Junior	9	1	2.694,39	14.549,71
Raquel Pérez Leal	Ingeniero Senior	1	1	4.289,54	2.573,72
		People month 2		**Total:**	17.123,43

[a)] 1 Person per month = 131,25 hours. Maximal annual dedication of 12 people per month (1575 hours)
Annual maximum for PDI in the Carlos III University of Madrid of 8,8 people per month (1.155 hours)

EQUIPEMENT AND TOOLS					
Description	**Cost (Euro)**	**% Usage dedicated to the project**	**Dedication (months)**	**Depreciation period**	**Chargeable cost [d)]**
Portable computer	650,00	100	18	60	195,00
Online planning tool (Tom's Planner)	0,00	100	0,2	60	0,00
Online survey system (SurveyMonkey)	0,00	100	2	60	0,00
Visio license	350,00	20	12	60	14,00
Office 365 student version	79,00	100	18	60	23,70
				Total:	232,70 €

[d)] Formula for the amortization calculus:

$$\frac{A}{B} x C x D$$

A = number of moths from the invoicing date in which the material is used
B = depreciation period (60 months)
C = equipment cost (without IVA)
D = % of usage dedicated to the project (usually 100%)

Figure 52 Cost estimate I

SUBCONTRACTED TASKS		
Description	Company	Chargeable cost
	Total:	0,00 €

OTHER DIRECT COSTS OF THE PROJECT [e)]		
Description	Company	Chargeable cost
Trips		27,20
Electricity		180,00
	Total:	207,20 €

[e)] This chapter of expenses includes all the expenses that were not taken into account in the previous concepts, for example: perishable goods, trips and trip expenses, others…

6.- Costs summary

Cost type	Total cost estimates
Staff	17.123
Equipement and tools	233
Subcontracted tasks	0
Other direct costs	207
Indirect costs	3.513
Total:	**21.076,00 €**

Figure 53 Cost estimate II

List of acronyms used

AdPM, 23
Achievement-Driven Project Methodology

AIEPRO, 17
Asociación Española de Ingeniería de Proyectos

APM, 17
Association of Project Management

APMBOK, 17, 18
APM Body Of Knowledge

CCPM 21, 82, 116
Critical Chain Project Management

CP, 20+
Closing a Project

CS, 20
Controlling a Stage

DAD, 27, 37
Disciplined Agile Delivery

DP, 20
Directing a Project

DSDM, 27
Dynamic Systems Development Method

i.e., 15, 21, 29, 48, 65, 82, 112
"id est", this is

ICB, 16, 17, 18
IPMA Competence Baseline

IP, 20
Initiating a Project

IPMA, 16, 17
International Project Management Association

ISO, 21
International Project Management Association

ITIL, 4
Information Technology Infrastructure Library

MoSCoW, 27
Must Should Could Want

MP, 20
Managing Product Delivery

MPMM, 20, 21, 57, 58, 59, 73, 76, 84, 91, 112, 113, 116
Method123 Project Management Methodology

NCB, 17
National Competence Baseline

PMAJ, 17
Project Management Association of Japan

PMBOK, 11, 12, 16, 17, 18, 19, 20, 21, 22, 37
Project Management Body Of Knowledge

PMCDF, 16
Project Management Competence Development Framework

PMI, 5, 11, 12, 16, 41
Project Management Institute

PMP, 11, 12
Project Management Professional

PRINCE2, 19, 20, 21, 59
Projects in Controlled Environments version 2

SB, 20
Stage Boundary

SMART, 65
Specific, Measurable, Attainable, Realistic/Relevant, Time-bound

SU, 20
Starting up a Project

SYSMA, 48, 62, 66, 74, 77, 81, 82, 83, 84, 85, 89, 92, 96, 98, 106
The name of the project managed in the business case (from System Maintenance)

UPMM, 22, 23
Unified Project Management Methodology

W, 83
Week

WBS, 80
Work Breakdown Structure

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